RAILROAD GAZETTE

ESTABLISHED IN APRIL, 1856.

PUBLISHED EVERY FRIDAY BY THE RAILROAD GAZETTE AT 83 FULTON STREET, NEW YORK
BRANCH OFFICES AT 375 OLD COLONY BUILDING, CHICAGO, AND QUEEN ANNE'S CHAMBERS WESTMINSTER LONDON

CONTENTS

VOL. XL., No. 12. FRIDAY, MARCH 23, 1906.

In the contributors' column this week there are two letters from correspondents about our editorial entitled "An Experiment in Reduced Passenger Fares," printed in the *Railroad Gazette* March 9. These letters are self-explanatory, and we think that our editorial also made its point of view clear; but, to remove any doubts, we wish to reiterate the statement we made at that time that it is obvious that there are a great many railroads which are physically unable to follow the example of the New York, Ontario & Western in making a uniform passenger rate. So far as the application to general practice is concerned, it seems most desirable, however, that fares should be as simple as possible. The passenger traffic manager is so accustomed to making his calculations to provide for diverse and complicated kinds of business that he does not always realize the feeling of helplessness with which the passenger tariff is apt to impress the passenger, particularly on western lines. We have at no time advocated a general adoption of a uniform rate of two cents per mile, or of any other sum per mile, throughout the railroads of the country; but we do believe that a simplification—even a radical simplification—of passenger tariffs would not only be possible, but would be very helpful in engendering a spirit of confidence and good feeling on the part of the traveler towards the railroad.

The disastrous butting collision of passenger trains last Friday morning near Adobe, Colorado, reported in another column of this paper, appears to have been due directly to over work of a telegraph operator, for which the public will hold the employer at least equally responsible with the operator; for the fact that the day man remained on duty at night without permission will not be a sufficient defense. The officer in charge will be judged responsible for not detecting and preventing such a risky proceeding. But though this is true, the reports indicate that the main and immediate cause was a moral delinquency of the operator. The trouble was not that he fell asleep, but that, when awake, he told the despatcher that No. 3 had not passed, when he did not know whether it had passed or not. Railroad managers have plenty of sins to answer for, but trusting sleepy operators to stop trains is not one of them; and those editors who predicate their censure on the allegation that "Operator Lively, while asleep, allowed a train to pass for which he held an order," should correct themselves. Lively did not have the order when No. 3 passed. If he had had it, his stop signal, which does not sleep, would have been displayed and would have stopped the train. The despatcher would not have sent the order until first assured that the signal was displayed; and the setting of the signal and giving the assurance would have been done in the regular and simple routine. The case is one more disheartening instance of a man who knows his duty, but lacks the moral courage to do it when doing it may involve a little censure. Rather than admit having been asleep, and by such admission risking the loss of a dollar, this operator risked—and lost—a score of lives. Getting operators with moral courage is not easy in the wilds of Colorado, and some railroad men will for that reason be lenient in their judgment of the man who appointed this operator. But there is a deeper question than that. Getting operators with strength of character is not easy, either East or West, on the plan usually employed. A better plan is needed. How many of your own operators can be trusted to frankly report irregularities for which they themselves are wholly or partly to blame? Only yesterday an officer of an eastern trunk line told us of continued difficulty in getting operators and signal men on his road. Not long ago a road in Pennsylvania deferred the adoption of the block system on certain lines because of the difficulty of getting reliable men who would work all day (or all night) in the woods, remote from civilization. Clearly, it will be necessary, if competent men are to be secured, not only to pay more money, but also to give the good treatment, vacations and careful instruction and counsel that competent men desire. And how about moral courage among superintendents and despatchers? Only a few months ago we had occasion to report an instance on an eastern road—another trunk line—of a signalman working 36 hours on a stretch. As we have said, going to sleep is not the greatest fault in the signal or telegraph service, for the rules, in a very simple way, provide against disastrous results from that kind of neglect; but how can a superintendent bear to be responsible even for the secondary cause of a collision? The Denver & Rio Grande apparently empowered despatchers to permit over work. Other roads do the same. Do we realize how very cautiously such power ought to be exercised?

Those who are working for the passage of compulsory block signal laws, whether in Congress at Washington or in the Massachusetts legislature at Boston, will have no lack of impressive arguments. The regular record, published by the Interstate Commerce Commission every three months, does indeed afford examples enough; but cases like Adobe, burning the bodies of a dozen victims beyond recognition, serve to more effectually arouse our hardened sensibilities. It should be carefully noted that the argument for the block system remains unshaken, notwithstanding the fact that, with the manual system, a sleepy operator may make trouble with the space interval as well as with the time interval and despatcher system. But, although a block signal operator—by collusion with another operator, or through the coincident neglect of an engineman—can cause a collision by sleeping if the circumstances are favorable, the fact remains that such cases are rare. The difference in the routine is radical. With or without better moral character in the men, or better training, the block system is more practicable, sure and safe. It is operated by few and simple processes, requiring little time. Despatchers' orders are written, transmitted and made effective by numerous processes, requiring much time. These are to a large extent simple, when

viewed singly, but they become complicated when we take into consideration the details connected with the handling of numerous orders at the same station at the same time, or think of the exacting nature of the mental problems imposed on the despatcher. An efficient and reliable signalman, like an efficient and reliable telegraph operator, is the product of training, experience and moral qualities. Failures come about from a lack of any one of these three elements. The block system has the advantage of requiring less training, which is due to the simpler processes. The train-despatching system is worked by a constant succession of exceptions to the rules; the block system by constantly following the rules, with very rare exceptions. A block-signal operator must have a regular habit of being awake for every train; under the despatching system the operator who desires to sleep is frequently finding occasions on which he can be off guard and no harm ensue. His reputation will be harmed if the despatcher finds him out, but frequently the despatcher is too busy to watch him. Thus we see that the block system puts a lighter tax on the moral as well as on the mental faculties. The block system in its crudest form is bound to improve the conditions when it is introduced on any road where the traffic necessitates placing much dependence on the despatching system; but why not have track-circuit control and thus still farther eliminate the puzzles and trials of mental and moral training? This is what the Southern Pacific is doing. If we had government investigation of accidents we might then have light thrown on the question whether such protection ought not have been provided on the Denver & Rio Grande.

THE RIGHT TO ROUTE YOUR FRIEGHT.

The decision of the United States Supreme Court in the California orange-routing cases, reversing the Circuit Court and the Interstate Commission, which was briefly noticed in the *Railroad Gazette* March 2 (General News Section, p. 66), is a fine example of Dutch justice; it is the unanimous decision of the nine justices, and is written by Justice Peckham. The acts charged against the railroads are not in terms prohibited by law, and, therefore, "a court is bound to consider the bearing which the result of its construction will have on the general purposes of the act." The Atchison and the Southern Pacific, by routing the enormous shipments of oranges and lemons for Eastern cities over such Eastern roads as they saw fit, succeeded in stopping the costly competition which those Eastern roads had indulged in (by means of secret, illegal rebates) and in that way resonable and undiscriminating rates were sustained and fair dealing promoted. The general result being for the public good, the technical difficulties of the law which a year or two ago guided the judges of the Circuit Court and four of the five Interstate Commerce Commissioners are now minified by the Supreme Court until they vanish from sight, and the railroads are justified. Some of the most refreshing judicial decisions that the courts give us are those in which they brush aside sophistries in order to make a statute press harder against an offender who has taken care to respect the letter while violating the spirit; here we seem to see the opposite. The spirit of the public tariff law and of the anti-pooling law were violated; but technically, Justice Peckham makes out that they were not violated.

It will be recalled that the Interstate Commerce Commission based its decision that the railroads were wrong mainly on the fact that the clause forbidding shippers the right to route their freight violated the law regulating the establishment of through routes. A through route and rate having been established, it should be open to all shippers and at all times, except as the tariffs might be modified after due notice and publication, as required by the law. Therefore, when the railroad reserved to itself the right to designate the route, it would be holding a route open to a given shipper at one moment and perhaps closing it to him the next moment. In pretending to give the shipper something in return for this privilege the road was making a false pretence, for the rate, as shown in the tariff, is guaranteed by the law, and the railroad cannot give any additional or greater guarantee. It is a contradiction to say that the tariffs create on the one hand many through lines, each open at all times to the initial carrier, while none is at any time open to the shipper except in the varying discretion of the initial carrier. Railroads have objected to the formation of through routes by the government because they might thereby be forced to make contracts with insolvent connections, but here they impose this condition on the shippers. Chairman Knapp filed a dissenting opinion, holding that, having given notice in the tariff that the through rates were conditional, the tariff was lawful. Roads are free to make or refuse to make through routes, and if they make them they may attach reasonable conditions; they may discontinue the through route and rate when they see fit; and Chairman Knapp is now sustained.*

Justice Peckham all through his decision emphasizes the fact that the shipper suffered no important detriment. Though the railroads reserved the right to route the oranges contrary to his wishes they seldom did so; they usually carried out his directions. The freight reached its destination as early as if routed by the shipper, and "in that event the particular route taken is not very important to the shipper." The freight was sent over the best roads in the country; those which were shut out were the roundabout roads. Witnesses gave no evidence as to any road being insolvent. The court must consider the possible evil results of an arbitrary application of the routing rule; but no such results were discovered. On the other hand, the railroads, by doing the routing themselves, stopped the rebating, which formerly had been flagrant among the Eastern roads. One shipper testified that in four years his company had received in rebates $174,000. This was done through the refrigerator car companies, yet it was a bald violation of the law, nevertheless. There is no pretence that the railroads discriminated between shippers.

The Circuit Court, in reviewing the order of the Interstate Commerce Commission (to abolish the conditional tariff) paid little or no attention to the arguments which were elaborated by the Commission and which are summarized above, but held that the routing rule was equivalent to a pool. It was agreed to between the initial carriers and the Eastern connections, and had the effect of stopping the competition between these Eastern connections. (The Circuit Court is justified by the Supreme Court in its placing of the emphasis on the question of pooling; the court is not bound to confine itself to the grounds specified by the Commission.) Justice Peckham then goes on to reverse the Circuit Court; and this mainly on the ground that although all of the good effects of a pool were produced, there was no actual agreement to pool. The Eastern roads simply were satisfied that it would be better to allow the initial lines to distribute the freight than to continue the practice of rebating; they believed that they would be fairly treated; and it was testified that not one of the Eastern companies knew what percentage of the business it received. They simply knew that rates were maintained. In short, there was no written pooling agreement, but there was a very effective "blind" pool. The Eastern roads trusted to the Southern Pacific and the Atchison to manage their pool for them satisfactorily, and the trust was not betrayed.

The Commission called this arrangement a tonnage pool, for the initial carriers certainly did divide the shipments with a view to giving each connecting road a proper share. The object was declared to be not so much to prevent rebates as to effect a tonnage division. Mr. Justice Peckham, on the other hand, holds that the main purpose was to break up the rebating, and therefore he decides that what was done was not repugnant to the anti-pooling law. He apparently couldn't see how these two things are inter-related. The rebates were the weapons in a fight for getting business; a pool when adopted or put in force is designed to secure business without having to fight for it. The essence of a pool is the peaceable division of competitive business, and the essence of this agreement was precisely the same.

Finally, Mr. Justice Peckham holds that the Eastern connections were not really competing roads. The initial carriers rightfully entered into agreements with the different Eastern lines for joint through rates, and could make any desired terms with any one of them, provided these were not in violation of other provisions of the act; and the only way that an Eastern connection could compete with another Eastern connection would be by violating the through tariff which had been made by the initial carrier and which the connection had agreed to. This, says Justice Peckham, would be unlawful; therefore, it could not properly be done; therefore the Eastern line could not compete with its rivals. The fact that the Eastern road *could* easily kick out of the traces; could, as often as found desirable, say every few days, call upon the initial carrier to change the tariff—change it according to law—does not occur

*The through tariffs, showing the rates over 183 different roads, contain a clause expressly stating that in guaranteeing the through rate the road reserves the absolute right to route the freight. Shippers are all the time diverting carloads of oranges to new destinations after they have made part of their journey. Shippers claim this privilege as a legal right; and to divert to advantage they must know where these cars are while on their way East. Usually the roads route cars as requested.

For seven years previous to 1900 all shippers received rebates of $15 to $25 a car; this was paid by the refrigerator car companies and by the eastern railroads. The California roads claim that their action in routing the freight (beginning Jan. 1, 1900) was necessary to stop this payment of rebates. It appears that the general eastbound tariff of the roads, covering all commodities, has the same clause denying shippers the privilege of routing their freight.

to Justice Peckham, apparently. He says that "all that would be needed for a total suppression of rate competition among the Eastern connections would be the honest fulfillment of their agreement as to joint through rates." If the law had required such agreements to be kept unchanged for a month or a year, this reasoning might hold water; but traffic men will not be able to see it in that light.

The complaining shipper will have to interpret this decision as holding that the right of a California shipper to decide what road he will patronize—say, between the Mississippi river and the Buffalo-Pittsburg dividing line—has in this matter been so very slightly infringed that he has no claim of any consequence for damage. Probably this is as near justice as we could expect. As the railroads are carrying the fruit at exceedingly low rates, and as the initial carriers themselves maintain a pretty vigorous competition (in facilities) it is probable that the decision works substantial justice; but to hear this kind of philosophy from hair-splitting and precedent-bound lawyers is an unfamiliar sound.

THE EVOLUTION OF RAILROAD TAXES.

The fact that the State of New Jersey has been passing through an "equal tax" contest with new and additional taxation of railroads in the foreground of the general issue is one of many reminders—in these days of rate bills and two-cent-a-mile statutes—of legislative activity in various railroad directions. Most of these measures can be summed up in the word "taxation," using that word in its very broadest sense. What, for example, in its final analysis, is the two-cent-a-mile proposition but a tax or impost upon the operating railroad corporation in the form of reduced rates to be distributed among passengers in proportion to distance traveled? And, on the tongues of economists and statists, equality of rates can be readily enough transmuted into equalization of a tax on transportation. The whole situation is rich in its emphasis on the subject of railroad taxation and its deep problems, whether those problems be considered historically or in the flickering lights of the future. We are now referring, however, to direct taxation of the railroad corporation by the state or municipality—not to the indirect forms of impost under the head of "regulation," though we are by no means sure that regulation may not at last reach the point where its contacts and collisions with normal forms of taxation may be serious.

Some years ago a New York railroad tax commission said in its report: "There is no method of taxation possible to be devised which is not at this time applied to railroad property in some part of this country." Not long ago we had a more personal illustration of railroad tax intricacies. Applying to the able head of a railroad commission in one of the oldest states of the Union for information as to the system of taxation of railroad bonds in his commonwealth, we were referred by him to the attorney-general of the state with the remark: "So complex are our railroad taxes that I don't understand them myself, and never did." Nevertheless, when one takes the wide and, so to speak, landscape view of railroad taxation in the United States, one can find some encouraging evolutions in the direction of scientific and harmonious methods. Order is coming out of chaos, but coming very slowly. It would have arrived more quickly if changes in the character of American communities on the one hand and of the physical conditions of railroad management on the other had themselves been less continuous and radical. The pioneer Western town once yearning for the railroad and willing to exempt it from taxation for a long term of years has since grown to the big city that wants to exact what taxes it can get. And the once isolated and independent railroad line has since become part of a great system with its fresh group of taxation problems imposed by interstate traffic if by nothing else. Taxation questions have thus been tangled by mutations both in the taxing power and the thing taxed.

The important forward step in railroad taxation during the last two decades has been the rapid transition from local to centralized taxation. From the varying systems of local appraisal, from the whimsical moods and tenses of municipal boards of assessors, and from habits and customs, dating some of them back to town or county organization, there has been throughout the country a progressive movement toward the centralizing of taxing power and functions in the state usually in some kind of a board. It is true that taxation of railroad property not directly used in operation is still in many states left to local authority. But essential justice is here generally reached by allowing the subtraction of such properties from state appraisals. If we are not mistaken only one state—Rhode Island—still holds with some persistency to the local system. The gain has been considerable. State tax commissions, with all their infirmities and under the evil impact of politics, have, nevertheless, been forced to consideration and study of principles in railroad taxation. Just as in New England the old district school system has had to yield almost universally to centralized control by municipal boards—higher as to intelligence and experience—so the change from local to state taxation of railroads marks the transfer to a higher order of taxing agency, and some coherency and uniformity have been substituted for the old local diversities. The fact that the state taxing agency often has the local distribution of the railroad tax receipts—in Eastern states among cities and towns, West and South in the counties—has no immediate bearing on the merits of the change.

Excluding those state taxation boards, which have been the temporary products of demagogism there has been, on the whole, in state taxation a discernible tendency to reach honest and equitable generalizations as tests of railroad values for a basis of taxation. It has taken a number of forms. Gross earnings is one, taxation of which, however, while plausible in theory, has not been very successful in practice, and has borne hard on struggling lines. Absolute appraisal, as though it were a piece of realty, of a railroad's whole plant within state bounds with apportionment of equipment to mileage, has been another pleasant theory that has proved infirm in practice. More successful and, on the whole, representing a growing tendency, is taxation of railroad debt—usually on a basis of par—and of stock on a basis of market values not always easy to ascertain. It has the merit—if just estimate is made as to values of interstate lines within the state—of reaching that market appraisal—including value of franchise—which is the common basic principle of public taxation of all kinds. But we are not going here *in extenso* into the relative merits and demerits, so often discussed, of the various tax systems. We are merely pointing out tendencies and the slow but steady drift toward scientific railroad taxation, the more encouraging because entangled by the rulings of the courts against state taxation of interstate traffic.

It is unfortunate that the progress toward general principles of taxation as between the public and the railroad corporations has not extended in the same degree to the individual holder of railroad securities. As a resident holder of securities of a domestic railroad corporation the resident owner of stocks and bonds is fairly protected. But, as a non-resident or as a holder of securities of a railroad outside the state, he is still overmuch a target of unjust taxation and the victim of some amazing anomalies very fruitful in tax dodging. Take but a single case: Under the Connecticut law the resident escapes all tax on bonds of Connecticut railroad corporations and of shares of outside railroad corporations. But, under a special and exceptional proviso, he is held for taxes on bonds of outside railroad corporations whether those bonds have been subjected—as a debt of the railroad corporation—to outside taxation or not. It is hardly strange that, under the circumstances, to abate tax dodging. Connecticut, some years ago, passed a law allowing such a bondholder to substitute for the municipal tax a lower bond tax to be paid to the state. This case is cited, in an old state where tax laws ought long ago to have passed their formative and plastic stage, to show what a large vacuum still remains for the redress of the double taxation of the ignored and victimized railroad security holder.

With state laws for railroad taxation still greatly lacking in uniformity, with legal principles of state taxation as yet much unsettled and with the swift growth of railroad consolidation bringing interstate complications to the front, there has been some tendency of late to discuss the question of federal taxation of railroads as a general substitute for taxes by the states—the assumption being that the receipts are to be redistributed to the states on a basis of their relative railroad interests. The proposition is speculative and academic, and cannot be described as a real tendency, though, in a broad way, suggested by recent federal activity in relation to railroad corporations. Even as a remote ultimate it seems very unlikely. As a form of redress, in the uncertain future, some railroad corporations may come to favor it so as to escape undue state exaction and irregularities of tax laws. But, saying nothing of obvious political dangers and the transfer to federal authority of a function so immense and so complex, the control in taxation of so vast an interest as that of the railroads is something we shall never see the states lightly yield. The idea belongs to that general appeal to federal paternalism just now popular with certain groups of Americans, but, in the near future, more likely to wane than to wax.

There remains for brief consideration the future tendencies and

ultimate shapes of taxation of the great and growing material interests represented by the street railways. The prognosis follows closely the analogy of the steam roads. At first, as localized institutions, local taxation modified in many states by a state collecting agency with redistribution to the municipality; later, as the local railroads extend, cross state lines and become freight carriers, a tendency toward uniformity of taxation and probably toward some diversion of tax revenues to the state treasuries; and, finally, under new mergers with old steam corporations the treatment, for purposes of taxation, of street railways as though they were integral parts of the steam system—perchance by that time itself electrified. The trolley is yet young, but in its rapid, if brief, life story it has already in so many aspects repeated the longer annals of the steam roads that its future in taxation can be, with reasonable certainty, foretold.

United States Steel Corporation.

The annual report for the year ended Dec. 31, 1905, shows gross sales and earnings of $585,331,736, an increase of more than $114,000,000 over 1904 and of $24,821,257 over 1902, when gross earnings were $560,510,479, the largest in the company's history. The net earnings of 1902—$133,308,764—still remain the largest on record. Last year's net earnings were $119,787,658, an increase of $46,611,136 over 1904. The surplus for the year was $17,065,815, an increase of over $12,000,000. The total surplus on December 31 stood at $84,738,451, a gain of over $23,000,000 above the figure a year earlier.

The following are extracts from the remarks of the President: "The production of pig iron, steel ingots and finished products for sale exceeded that of any previous year. It can be attributed largely to the liberal expenditures made during the last four years in improving and expanding the properties that it was possible to accomplish the record-breaking results in production and handling of business which resulted for the year, and consequently to realize the amount of net earnings shown. Although the capacity of the producing furnaces and mills at Chicago and vicinity has been materially increased from time to time, it has not kept pace with the increased and rapidly increasing consumption tributary to this location; and therefore a large percentage of this tonnage is now supplied from Eastern mills. In consequence, it has been decided to build a new plant on the south shore of Lake Michigan, in Calumet Township, Lake County, Indiana, and a large acreage of land has been bought for that purpose."

The following table shows the source of the company's production of iron ore and other facts about production for the past three years:

Iron Ore Mined.

	Tons		
	1905.	1904.	1903.
From Marquette range	1,359,722	934,512	1,412,402
From Menominee range	1,871,979	1,186,104	2,106,443
From Gogebic range	1,671,747	1,271,831	1,867,856
From Vermilion range	1,578,626	1,056,430	1,918,584
From Mesaba range	12,004,482	6,054,210	8,058,070
Total	18,486,556	10,503,087	15,363,355
Coke manufactured	12,242,909	8,652,293	8,658,391
Coal mined	2,204,950	1,998,000	1,120,733
Limestone quarried	1,967,355	1,393,149	1,268,930
Blast Furnace Products.			
Pig iron	9,940,799	7,210,248	7,123,053
Spiegel	158,071	100,025	121,779
Ferro-manganese and silicon	73,278	59,148	34,409
Total	10,172,148	7,369,421	7,279,241
Steel Ingot Production.			
Bessemer ingots	7,379,188	5,427,979	6,190,660
Open-hearth ingots	4,616,051	2,978,399	2,977,300
Total	11,995,239	8,406,378	9,167,960
Finished Products.			
Steel rails	1,727,055	1,242,646	1,934,315
Blooms, billets, slabs, sh't & tin plte brs	1,253,682	932,029	493,292
Plates	780,717	404,422	519,713
Heavy structural shapes	484,048	313,779	362,765
Mrchnt st'l, skelp, hoops,bnds & cot. ties	982,782	577,384	634,830
Tubing and pipe	911,346	710,765	710,555
Rods	84,049	84,934	101,699
Wire and products	1,283,943	1,226,610	1,126,605
Sheets: black, galvanized and tin plate	924,439	735,482	763,670
Finished structural work	404,732	357,488	469,692
Angle and splice bars and joints	150,265	72,470	138,709
Spikes, bolts, nuts and rivets	61,496	46,003	53,259
Axles	149,596	62,981	119,716
Sundry iron and steel products	28,236	25,787	30,059
Total	9,226,386	6,792,780	7,458,879

NEW PUBLICATIONS.

Building Code. Prepared by The National Board of Fire Underwriters, New York. Leather, 6x9½ in.; 263 pages.

This work has been prepared by the National Board of Fire Underwriters, through the Committee on Construction of Buildings, for the purpose of securing uniform building laws throughout the country. Every effort has been made to make it as complete and comprehensive as possible, and the committee has been assisted in its work by experts of the highest authority in the art of building construction. In the belief that good construction should be recognized as of the utmost importance in every city and town this work, as prepared and recommended, has been based upon broad principles, hoping to impress upon municipal authorities everywhere their grave responsibility in enacting and enforcing laws for the protection of life and property. The work is somewhat voluminous owing to the efforts of the committee to provide for conditions existing in towns as well as cities. It covers all matters concerning, affecting or relating to the construction, alteration, equipment, repair or removal of buildings or structures erected or to be erected. The work is nicely printed and is bound in a flexible cover. It contains an alphabetical index, as well as marginal subheads which will be found most useful for ready reference.

TRADE CATALOGUES.

In 1894, the Master Car Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. The advantages of conforming to these sizes have been recognized, not only by railroad men, but outside of railroad circles, and many engineers make a practice of immediately consigning to the waste basket all catalogues that do not come within a very narrow margin of these standard sizes. They are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.

Standards.

Postal-card circulars	3¾	in. by	6⅛	in.
Pamphlets and trade catalogues	3½	" by	6	"
	6	" by	9	"
	9	" by	12	"
Specifications and letter paper	8¼	" by	10¾	"

Reinforced Concrete Construction.—A treatise on reinforced concrete construction has just been issued by the Northwestern Expanded Metal Company, Chicago. It deals with the value of expanded steel and its application to reinforced concrete in every form, giving tables and calculations for its use. It shows the comparative value of concrete and steel when used together, giving simple rules for determining their proper proportions and their easy and practical application to all classes and kinds of structural work. The principle and disposition of concrete and steel sections as laid down in this book demonstrate the value of expanded steel in the construction of beams, columns, girders, floor slabs, and, in fact, anything made of concrete. The book is a convenient size for the pocket and ready reference. Copies can be secured by writing the company at 790 Old Colony Building, Chicago.

CONTRIBUTIONS

Shavings Cut from the Outer Rail.

Roanoke, Va., March 18, 1906.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In connection with the article by Mr. S. Whinery, and your comments thereon in your issue of March 16, 1906, relative to shavings cut from outer rail on curves by wheels of passing locomotives and cars:

I have on several occasions found shavings such as were described in the *Railroad Gazette* for April 4, 1905, on curves at outlying points on heavy grades where the outer rail was elevated for a high rate of speed. Trains on descending grade running at rate of about 45 miles per hour, the curvature being about 6 deg. On these curves the loaded movement is in the direction of the ascending grade. My explanation of excessive curve wear would be that with the very slow movement of the loaded trains, the high elevation of the outside rail throws a great preponderance of the load on the inner rail and holds the trucks rigidly in tangential position or possibly by reason of the wheel tread being coned and the inside wheels running on the larger diameter the tendency is to slew the truck in direction contrary to the direction of the curve. I think both have an influence and the result is that the flange of front wheel on each rigid wheel-base is held firmly against the outer rail at an angle which with a sharp flange causes shearing, and in any case causes excessive flange wear of rails.

Where it is necessary to maintain a considerable superelevation for high rate of speed in one direction only, it is at the expense of power and wear of rails in the opposite direction, and is a greater hardship where the loaded movement is in the direction of the ascending grade, and speed in that direction must necessarily be very slow. My practice has been to ameliorate the unfavorable conditions as much as practicable by elevating the outer rail as little as is compatible with maintaining fair riding track on descending grade, and to have trackmen give particular attention to maintaining the track rails in position at right angles with the plane of the ties. The constant tendency is to tilt both rails out and widen the gage on curves, and as the rails tilt the flange wear increases rapidly. The tilting is caused by the oscillation of both engines and cars and by the greater weight being borne by the outside base of rail. To remedy the defect it is necessary at intervals to pull spikes and adze ties so that the rails will have

firm bearing in proper position. I have found that close attention to this matter by trackmen will secure at least 20 per cent. longer life for the rails on curves.

G. W. MERRELL,
Assistant to General Superintendent, Norfolk & Western.

An Experiment in Reduced Passenger Fares.

March 16, 1906.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In connection with your editorial on "An Experiment in Reduced Passenger Fares," in your issue of March 9, I call your attention to a study of railroad passenger rates indicating the effect of low rates in increasing revenue, which appeared in your issue of Feb. 10, 1899. As one of the traveling public, and something of an observer of human nature, I am firmly convinced that almost every individual who travels at all will go twice for two cents against once for three cents. I think it is this peculiarity of human nature that is responsible for the largely increased revenue that almost invariably follows a reduction of rates. But I agree with you, also, that uniformity of the rate has much to do in encouraging travel. Of course no rate can be put below cost, and the old rule of what the traffic will bear seems to be the proper one to follow, the chief difficulty being in determining just what the traffic will bear, that is to say, just what rate will produce the maximum net revenue. In the study of rates referred to above, the fact that low rates do increase revenues seems to stand out clearly, although I am aware that there may be other local reasons for the apparent gains.

WM. G. RAYMOND,
Dean of the College of Applied Science, State University of Iowa.

An Experiment in Reduced Passenger Fares.

Philadelphia, March 16, 1906.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Referring to article in your issue of March 9, "An Experiment in Reduced Passenger Fares," I want to take issue with some of the deductions you draw from your analysis of the situation on the New York, Ontario & Western—a line with little but local business, no heavy suburban traffic, and no expensive terminals to maintain—which found it desirable to reduce its passenger rate to two cents per mile.

The table you present shows an increase in gross passenger earnings of 72 per cent. from 1897 to 1905, and you attribute this increase to the reduced and uniform rate of fare. You must admit that all railroad earnings have largely increased during this period regardless of the rates charged. The gross passenger earnings of the New York Central & Hudson River, a two-cent-a-mile road, increased over 89 per cent.; the earnings of the New York, New Haven & Hartford, a two-and-one-half-cent-a-mile line, increased over 77 per cent., and the earnings of the Pennsylvania Railroad, a three-cent-a-mile road, increased over 94 per cent. These increases have been made without any change in the rates of fare charged. They prove, I think, that the increase on the New York, Ontario & Western has been only normal, and also that the general prosperity of the country and the activities of flourishing trade have had more to do with the increase than the reduction in fares, as the same result is shown on the three larger systems which have made no change in their varying rates.

Again, you fail to show the net increase in earnings. The increase in gross earnings from 1897 to 1905 has been accompanied by a corresponding increase in expenses, an increase on the Pennsylvania Railroad, for instance, of more than 98 per cent. The actual increase in net earnings on the New York, Ontario & Western, therefore, becomes an interesting question.

You have failed to mention an important consideration in the passenger business—the service provided. While none of the standard railroads has reduced its fares during the period covered by your article, it is well-known that marked improvements have been made in the service, and this is virtually a concession to the passenger, because he gets that much more for his money. Roadbeds have been bettered; a larger proportion has been rock-ballasted. Safety appliances have been perfected; the equipment has been greatly improved. More parlor and dining cars (which seldom pay) have been provided. Coaches have been made more comfortabel. Commodious and expensive terminals have been constructed. More frequent and faster trains have been added. It is not a general rule of business to reduce the charge when by large expenditures the service is improved. On the contrary the charge is usually raised.

The improvements in the service, representing an increase in the expense of performing it, have been equivalent to a reduction in fares. And it is here that the "contented mental state" is produced; for while the passenger naturally wants to pay as little fare as he has to, he always expects the best in the way of service. The progressive road is, therefore, constantly improving its service and attracting travel by this means. Compared with the service performed, I think you will find that the rates on the standard railroads of the country are as low as those which charge a flat two cent a mile rate. In fact, you will find that the average rate per mile on the principal trunk lines does not exceed two cents. It is simply adjusted to satisfy the various classes of patrons—it is made flexible rather than arbitrary. The flat two cent a mile rate is an advantage to the occasional traveler, but it would be a disadvantage and a hardship to the commuter and the frequent traveler.

I note your suggestion that "simplification of passenger charges to the extent that a man can go up to a ticket window anywhere on a road with the assurance that it will cost him (say) two cents a mile—no more and no less—to travel, and that the next man is paying as much as he and no less, has no small influence in increasing passenger earnings." This may be true, although it has never been tried, but I believe from experience that nothing would produce greater irritation and dissatisfaction among the traveling public generally than to charge everybody the same rate per mile.

The man who rides daily to and from his office insists upon having a lower rate than he who rides only once a week; the commercial traveler who rides frequently insists upon a lower rate than the occasional traveler, and the man who makes the round trip between one point and another within a limited period insists that he should have a lower rate than the man who goes and comes when he pleases; and every passenger man in the country knows that large movements are created only by a substantial reduction in rates.

Everything is comparative in this world, and passenger fares are no exception to the rule, and if a rate of two cents a mile were adopted on all the railroads in this country, the demand would very soon arise for a reduction below that figure. As an illustration, a bill has been introduced in one legislature this winter for a rate of one and one-half cents to apply in a territory where a two cent rate obtains very generally. If the price of a ticket is to be measured by the frequency of the trip taken by the purchaser, the restrictions which you criticise are unfortunately necessary to insure the observance of the contract of ticket by the purchaser, thus protecting the forms of transportation sold at higher rates.

We find that a "contented mental state" for the passenger is when he gets a better rate than some of his fellows, and it does not take a passenger long to find out that there is a round trip rate or a commutation rate by means of which a reduction from the standard fare may be secured.

The experience of the passenger agent is that a reduction in rates stimulates travel for a short period, but that the novelty soon wears off and the volume of traffic falls back to its normal condition. I think it is not well understood by those who write upon such questions that a large proportion of the business of the great railroads to-day is carried at reduced rates; and these reductions on special occasions are a great stimulus to travel. This stimulus is lost the moment a flat rate is established.

It is true that the electric lines have created travel in a great many instances, but the beginning of their prosperity resulted from underselling the competing steam roads, and the opportunities they have of using the highways and passing the door of the passenger at frequent intervals. The cheapness of the rates, of course, has much to do with this increase, but it will be found, if a careful analysis of the question is made, that the frequency of movement is also a most important factor, next to that of the lower rate, in taking from the competing steam road, with its less frequent service, the short travel. Where the electric lines have to pay their own right of way, and run in competition with steam railroads outside of the suburban territory adjacent to large cities, it will be found that many of them are not formidable competitors.

I think most of the men who have charge of the passenger traffic of the country would hail with delight the opportunity to make one rate, say two cents a mile, for everybody, but there are so many special rates for conventions, special occasions and excursions of various kinds, and commutation rates, demanded by the passenger interests that those in charge of the passenger traffic would be loath to endorse a reduction in the maximum fare.

The railroads in Ohio, having had their maximum fares reduced, are endeavoring to apply the flat rate to all classes of travel, but we observe that already they are being severely criticised for it, and are threatened with reprisals by municipal authorities through adverse and hampering legislation.

AN OLD RAILROADER.

Brown, Boveri & Co. have completed one of the electric locomotives which are to haul the trains through the Simplon tunnel. It is a 10-wheeled engine, 40 ft. 6 in. from buffer to buffer, weighing 68 tons, capable of developing 900 h.p. ordinarily and 2,300 at a pinch, and intended to run 21 miles an hour with freight, or 42 miles with passenger trains.

Santa Barbara Station of the Southern Pacific.

The Southern Pacific has recently completed at Santa Barbara, Cal., a very attractive passenger station in the Old Mission style of architecture, views of which are shown herewith. The walls are concrete, 14 in. thick, the concrete being composed of sand, fine gravel, crushed rock and German cement, and being faintly buff tinted wherever it shows either inside or outside of the building. The roof covering is full-sized, red, Old Mission tiles. The platform, including the portions under the baggage shelter, arcade and passenger shelter, is of bituminous rock laid on concrete. The arcade extends around the waiting room and office portion of the building, with an extra width at the passenger end affording large, out-door passenger waiting space and being supplemented by a porte cochere in the rear of the building, opposite the women's waiting room entrance. The baggage room is in the one-story part of the building and has a wooden floor and tongued, grooved and beaded side and top ceiling, with the usual baggage protection wainscoting; the baggage room being supplemented by an arcade baggage shelter at the end of the building. The private and public office rooms have wooden floors and quartered oak wainscoting and picture molding, the remainder of the walls and the ceiling being sand-finish plastering, buff tinted. Three ticket windows open from the office into the general waiting room.

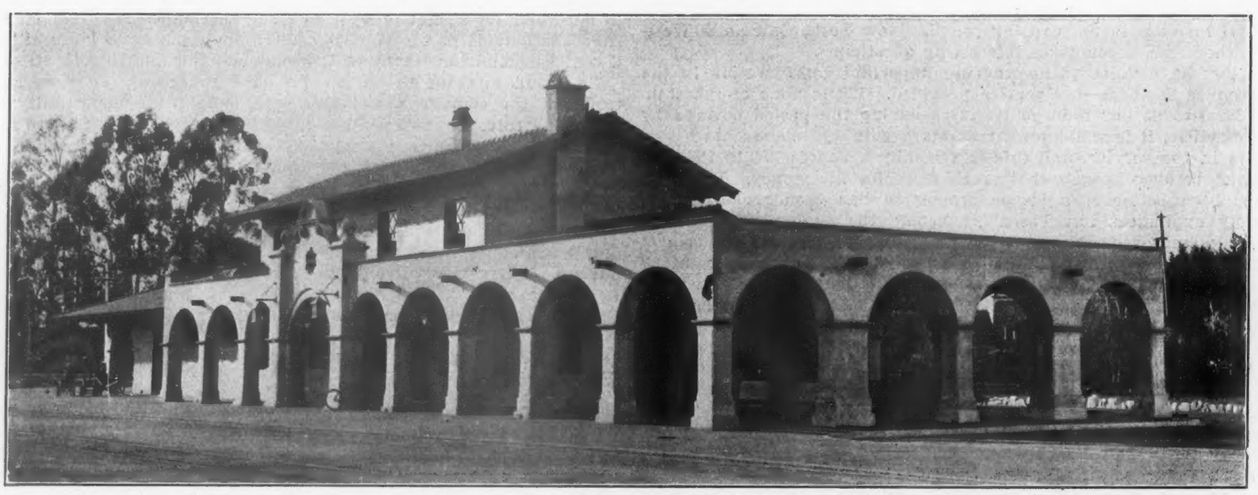
Street Side of New Station at Santa Barbara, Cal., Southern Pacific.

Fireplace in Ladies' Waiting Room.

The lavatory floors are ceramic mosaic, the wainscoting and partitions are of Italian veined marble, and the remainder of the walls and the top ceiling sand-finish plastering, buff tinted.

The general waiting room is in the two-story portion of the building and extends the entire height of the two stories. It has a ceramic mosaic floor with enameled tile wainscoting to the height of the doors with base of Tennessee marble, top molding and picture molding of quartered oak, sand-finish plastering, buff tinted, on remainder of walls, and a high open roof timber ceiling, antique-oak stained. The women's waiting room is in the one-story portion of the building surrounded by the arcade. It has a high open roof-timber ceiling, antique-oak stained, like the general waiting room, and the finish is the same as the latter.

All seats and other depot furniture are of quartered oak. The electric light fixtures were specially designed to correspond to the general style of the building, and all electric light, telephone and telegraph wires enter the building through conduits. The mantels around the fireplaces in the women's waiting room and general waiting room are of concrete, with buff sandstone fireplaces, and the over mantels are ornamented with plaster of paris plaques, bronze painted.

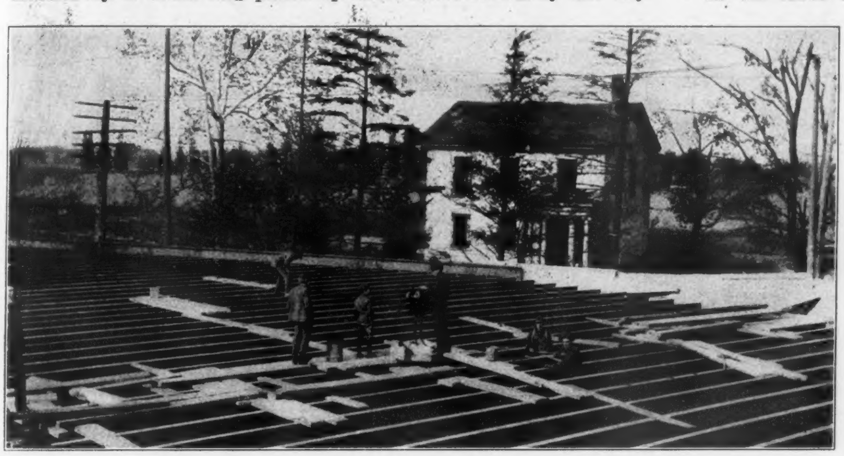


Track Side of New Station at Santa Barbara, Cal., Southern Pacific.

Grade Separation at Cleveland, Ohio.

BY GEO. H. TINKER,
Assistant Engineer, New York, Chicago & St. Louis.

The city of Cleveland, in common with other large cities, has realized the necessity of eliminating the grade crossings of steam railroads and city streets. The inception of work of this character dates back a number of years and its progress has in general been marked by a broad and public spirited consideration by the city authorities and the officials of the various railroads interested, as well as by a deep interest on the part of the citizens. In some instances, with a foresight not always in evidence, franchises have been granted to railroads with the condition that certain specified crossings should be separated at some future date when the interests of the city should require it, at the sole expense of the railroad. In the majority of cases the work has been done by the city and railroad jointly, each bearing half of the total expense. In all cases work has been taken up only as part of a comprehensive plan embracing the improvement of an entire section of the city or all the crossings on a single railroad, it being the intention that eventually all the grade crossings within the city limits shall be eliminated.



Showing I-Beam Floor—Detroit Street and Nickel Plate Grade Separation.

At the present time work is in progress at several different crossings. During 1904 Detroit street was taken under the Lake Shore & Michigan Southern tracks, the railroad being carried on a through plate girder bridge with solid ballasted floor. The city required a clear span the entire width of the street, necessitating a girder 102 ft. 5 in. long. The surface of the street was depressed 20 ft. 6 in., the subway grades being 4 per cent. At Wilson avenue a similar plan was adopted for eliminating the crossing with the Erie Railroad. In this case the span of the girders was shortened by placing bents at the curb line. The street surface was depressed 18 ft., and the subway grades are 4 per cent. This work will be completed during the present season. At the crossing of Broadway and the Pennsylvania Railroad also, the street is depressed and the railroad carried overhead. This work was begun in the fall of 1905.

In the three cases mentioned the general plan is the same. The street surface is depressed and the railroad carried overhead. At the crossing of the New York, Chicago & St. Louis Railroad and Detroit street the topography favored an opposite solution. The tracks of the railroad were depresesd about 4 ft. and the street surface raised about 15 ft., giving an approach grade from the east of 4 per cent. and from the west of 0.6 per cent. This is the first crossing to be treated in this manner. As the work of crossing elimination progresses there will be many others that will admit of a similar solution and it is possible that the type of structure adopted here will be more or less closely followed in other cases.

The abutments are of concrete founded on shale rock at a depth of a few feet below the subgrade excavation. These are extended to form retaining walls for the street approaches. In the construction of these walls vertical expansion joints were left every 30 ft. The concrete was machine mixed and dumped in the forms from a drop-bottom bucket designed by the contractor. Between the tracks were built three piers, each consisting of steel columns spaced 8 ft. 2 in. center to center and resting on concrete pedestals. These columns support cross-beams of 15-in. 42-lb. I-beams, and on these cross-beams and the abutments are the floor stringers of 15-in. 42-lb. I-beams spaced 3 ft. center to center. At each street line is a light fascia girder carried by the cross-beams and abutments. The floor stringers are placed perpendicular to the center line of the cross-beams and arranged to break joints. As the crossing is on a skew, as shown in the illustration, this brings the stringers at an angle with the street line. The short ends are riveted to the fascia girders.

Track Depression in Detroit Street and Nickel Plate Grade Separation.

Supported by the floor stringers is a slab of reinforced concrete 9 in. thick at the crown and 3 in. thick at the curb line. The reinforcement consists of 1-in. by ⅜-in. flat bars. This carries the regular street pavement and two street railway tracks. The two 11-ft. sidewalks are of 5-in. slabs of concrete not reinforced. The fascia girders carry a solid railing of reinforced concrete molded in place, as shown in the detail.

The entire structure is encased in concrete as a protection to the steel. Expanded metal and concrete covers the webs and bottom flanges of the I-beams and fascia girders. Between the columns of the piers an 18-in. curtain wall of solid concrete is carried up to a height of 5 ft. above the rail. Above this elevation the columns only are concreted. The object of this curtain wall is to lessen the damage by a derailed car.

Concrete Curtain Walls Completed and Columns Encased in Concrete—Temporary Floor and Railing for Use During Winter—Detroit Street and Nickel Plate Grade Separation.

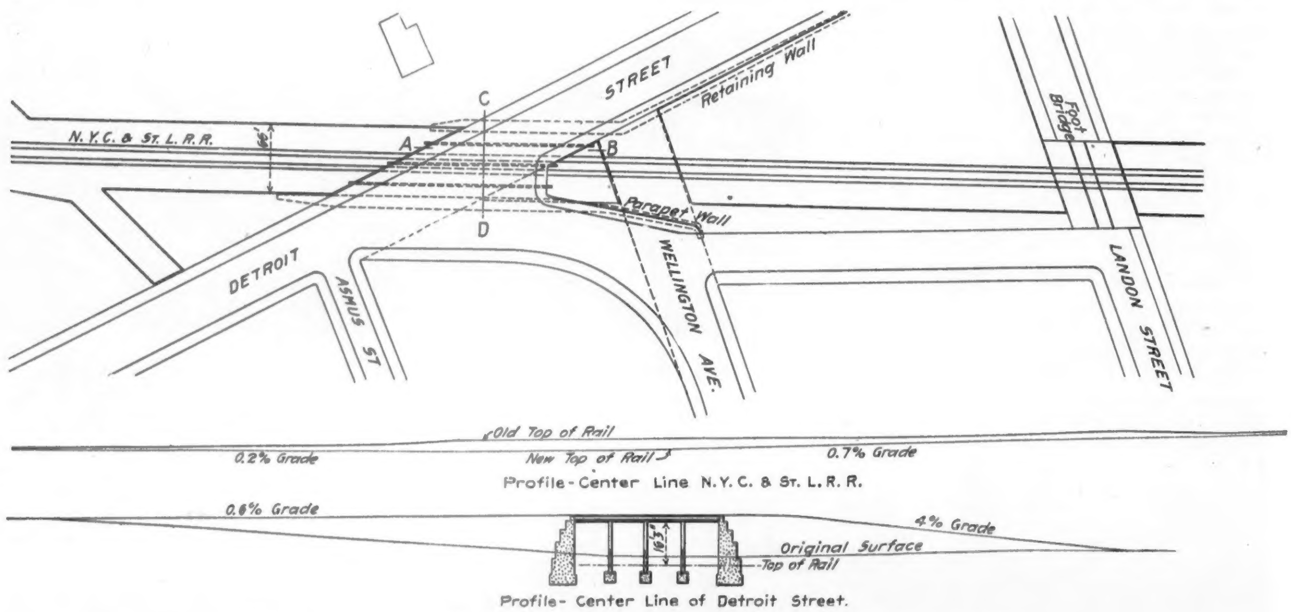
Construction was begun in the fall of 1904

by building as much of the retaining walls as could be built without obstructing the street. The work was then stopped until the spring of 1905, when the street was closed to traffic, the street cars detoured around the work, and the abutments were completed. Railroad traffic was then abandoned on the north half of the right-of-way and the work of track depression begun. A 65-ton steam shovel was used loading into dump wagons. The excavated material was used to fill the street approaches, the average haul being 750 ft. The average day's work for the steam shovel was about 400 cu. yds. The railroad company forces followed the steam shovel with ballast, and relaid the track which they had removed ahead of the steam shovel.

When one-half of the right-of-way had been excavated and the track relaid, traffic was diverted to that side and the shovel moved to the south side. Upon the completion of the excavation the pedestals for the columns in the piers between the tracks were built and the steel work erected. Concrete for the pedestals was hand mixed. These pedestals are founded on hard blue clay and shale at a depth of one to five feet below subgrade. There is in Detroit street a 6-ft. sewer built in tunnel, during the excavation of which the roof had caved where the sewer crosses the railroad. In excavating for the pedestals six of the pits penetrated the caved-in tunnel roof. Some old I-beams were secured and placed across the tunnel so as to insure that the weight of the bridge will not come upon the sewer but be carried by the undisturbed rock at the sides of the tunnel.

Showing Steel Columns in Piers and Forms in Place for Concreting Curtain Walls —Detroit Street and Nickel Plate Grade Separation.

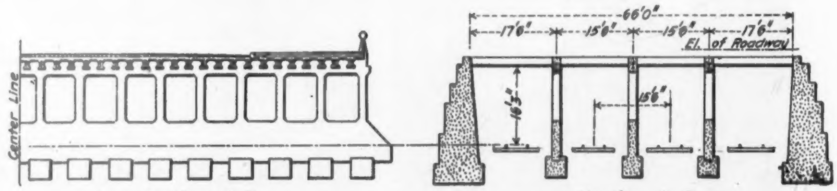
As soon as the steel work was erected and riveted the placing of the concrete metal protection was begun by concreting the columns and curtain walls. This work was completed to the level of the cross-beams in November, 1905, and there stopped for the season as it was not deemed advisable to continue this work in freezing weather. The half-tone illustrations show the work at different stages. The features of the steel work and the appearance of the piers with the concrete metal protection in place are clearly shown.



General Plan and Profile of the Detroit Street and Nickel Plate Grade Separation.

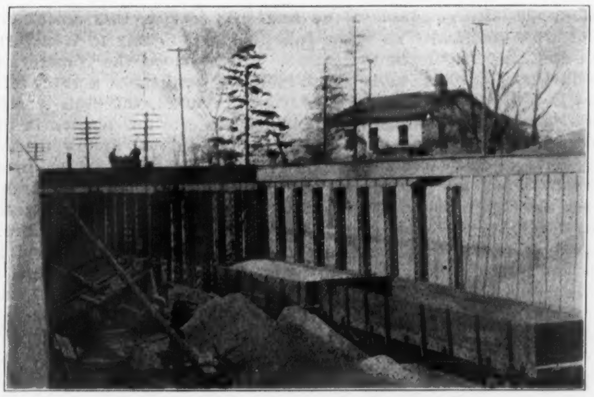
The total amount of material excavated was 25,100 cu. yds. The total amount of material filled into approaches was 28,600 cu. yds., of which about 1,500 cu. yds. came from outside sources. This would indicate that the excavated material, which ranged from sand to hard blue clay, swelled about 8 per cent.

There were in the foundations 3,537 cu. yds. of concrete. This was all mixed under the supervision of an inspector employed by the city. The proportions are 1 part Portland cement, 2½ parts sand and 5 parts stone. The stone is limestone from ½ in. to 2 in. in size. A sack of cement was assumed to measure 1 cu. ft. A careful tally of the number of sacks used each day showed exactly five sacks, or 1¼ barrels of cement per cu. yd. of concrete. The labor cost of concreting was about $1.40 per cu. yd., distributed as follows: Unloading materials, 13½ per cent., forms 21½ per cent., placing concrete 65 per cent.; wages were 15 cents and 17½ cents per hr.

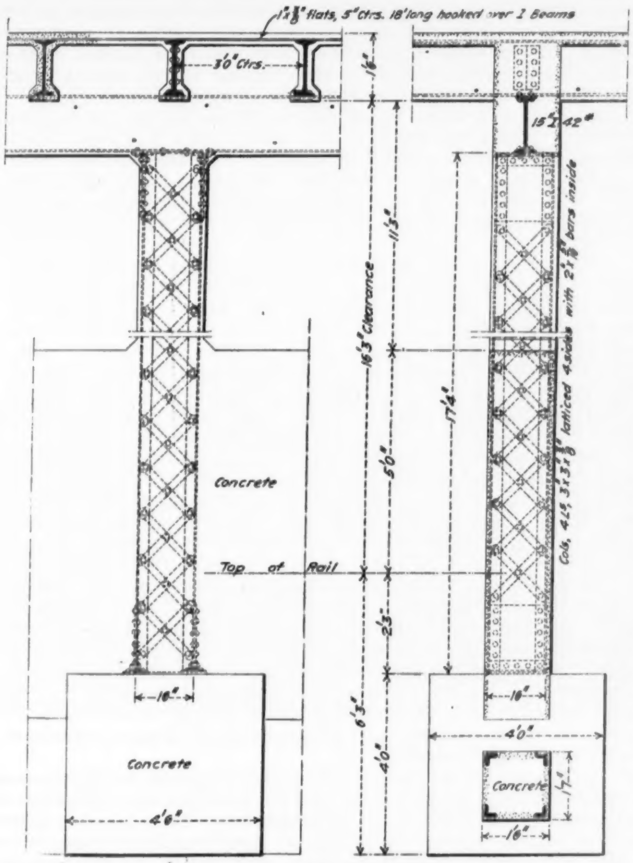


Sections Through Masonry—Detroit Street and Nickel Plate Grade Separation.

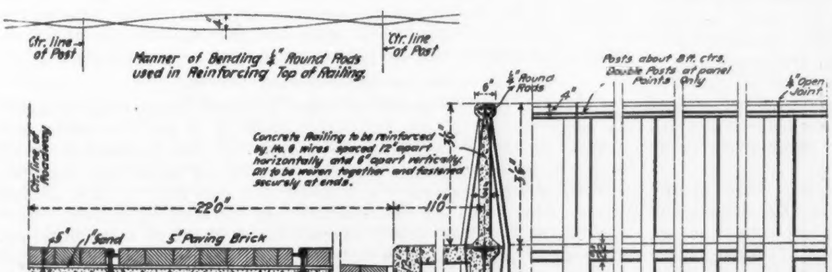
There are 132 tons of steel in the structure. The labor for erecting cost about $4.25 per ton, distributed as follows: Handling plant 26½ per cent., unloading material 7½ per cent., raising steel



Steel Erected and Concreting of Curtain Walls in Progress —Detroit Street and Nickel Plate Grade Separation.



Details of Concrete Steel Columns and Connections—Detroit Street and Nickel Plate Grade Separation.



Details of Floor and Reinforced Concrete Railings—Detroit Street and Nickel Plate Grade Separation.

36 per cent., riveting 30 per cent. All rivets are of ¾ in. diameter soft steel, and were hand-driven. The average day's work for a gang of four men was 162 rivets. The cost was 10.3 cents per rivet. The proportion of defective rivets was 3.14 per cent. Wages were 50 cents per hour.

The contractors for the grading and masonry was The Williams Bros. & Morse Co., of Cleveland. This part of the work was sublet to J. H. Bard & Co., of Toledo. The contractor for the superstructure was the Van Dorn Iron Works Co., of Cleveland. The concrete metal protection was sublet to Masters & Mullen, of Cleveland. The work was done under the supervision of W. J. Carter, City Engineer, and F. D. Richards, Bridge Engineer, of Cleveland, and E. E. Hart, Chief Engineer, and A. J. Himes, Bridge Engineer of the N. Y. C. & St. L. R. R.

Track Circuits in Place of Detector Bars.*

In running circuits through switches it is impossible to force the current to flow through every foot of rail, and the bonding to cross-overs and fouling points must be made as perfect as possible. Jumpers should be used for both positive and negative rails. Examination of track circuits through many interlockings indicates that signal workmen are apt to get lost in wiring through switches. A great number of bond wires are put on, but through failure to trace the circuits, wires at some one or two points are left off, making the continuity of one side or other depend on the contacts between switch points or switch plates and the stock rail or through the parts of frogs. It is equally important that a reliable person should take entire care of the bonding through switches, as the situations are too complicated to be left to the trackmen.

Where, to avoid putting in short pieces of rail, it is necessary to have a dead space, this should be as short as possible; always shorter than the wheel base of a four-wheeled caboose. Track circuits should be inspected and tested every day. This can be done by raising the latches of the levers controlling various switches when trains are moving over them and noting whether the locks pick up. One hand should be placed in front of the lever while trying it with the other so that if the lock is not holding, the lever cannot be moved far enough to throw the switch. These tests should especially be made with light engines or cabins on the circuits so that a momentary picking up of the relay might be detected. A fraction of the labor and expense required to keep detector bars in reasonably good order will unquestionably keep the electric locking working with practically absolute reliability. The attention required will be no burden to the repairman, and negligence due to the fact that failures are few should not be tolerated.

The repair man should be cautioned against the mistake of imagining that the only failures to be looked for are those which would keep the lever locked. When failures locking the levers up occur, the releasing, with few exceptions, should be left to the repairman. This can be done either by an application of battery at the lock terminal or by lifting the indication latch by hand. The circuits are usually short and as a general thing very little time is required in locating the trouble. As a mater of fact there are few instances throughout the use of elctric locking that switches must be operated any length of time without its protection.

Through Altoona yard there are six electro-pneumatic interlockings with a total of 68 working switch levers equipped throughout with electric locking. The results from its use at three of the larger plants and where the movement is heaviest are as follows: At the east end of the yard, a point where all traffic passes and where all westbound freight, with the exception of high-class trains, is taken into the yard, there are 11 working switch levers. During 1905 there were three failures on the safe side and one on the wrong side. This failure was caused by just enough dead space in a circuit to allow a momentary picking up of the relay while a cabin was being pushed through the circuit by trainmen. As the dead space was just a foot longer than that required for the wheels of a cabin to stand in, we can clearly understand to what degree the electric locking is depended on by the levermen to do its work. At the west end of the yard where all trains are carried through, and where the eastbound passenger tracks cross the westbound freight, there are 12 working switch levers with a scissors crossing and two double slips. From April 18,

*From a paper by W. N. Spangler, West Jersey & Seashore, read at the Chicago meeting of the Railway Signal Association, March 19.

1905, or when the entire interlocking was electrically locked, to Dec. 31, 1905, there were seven failures on the safe side and none on the other. The situation at the third interlocking, where there are 23 working switch levers, is particularly interesting. The plant was put in operation Dec. 17, 1905, and controls the movement to a receiving yard built from two ladders. At least 30 per cent. of the movements are made by swinging trains, which requires that after the engines have been cut lose and have run far enough to clear the locking circuits, the signals and switches must be changed, the trains allowed to run into the yard, the switches again changed and the cabins allowed to follow the engines. During the 48 days of service no failures of circuits were reported.

Revised Constitution for the Railway Signal Association.

At the Chicago meeting of this association, March 19, a committee consisting of J. A. Peabody, W. M. Camp and C. C. Anthony reported a revised constitution which, if approved, will go into effect, we suppose, next October. The new constitution consists of ten articles and embraces also those subjects usually put in a separate class and called by-laws. Provision is made for temporary changes where necessary. This constitution has evidently been prepared with great care and it embodies many improvements over that now in force. It is proposed to divide the active members into two classes. Railroad signal officers, including inspectors, supervisors and assistant supervisors, are called senior members, and all other active members "junior." Questions of standard practice are to be decided by a two-thirds vote of the senior members voting, though never at a meeting where less than 20 senior members are present. An honorary member shall be a person whose connection with the association may promote its welfare or a person of established reputation who has ceased to be actively engaged in signal work. Provision is made for expelling, at annual meetings, members who are guilty of dishonorable or unbecoming conduct, but an expulsion is not to be recorded in the published Proceedings. Dues are payable in the first three months of the calendar year for that year. The executive committee is to consist of the president, an eastern and a western vice-president, the secretary-treasurer, two executive members and the three latest living past presidents who are active members. Officers are to be elected separately by ballot, without nomination, and a majority is necessary to elect. The dividing line between the East and the West runs from Buffalo to Pittsburg and thence down the river to the Gulf of Mexico. A president shall not be eligible for re-election until five years after his first incumbency, and vice-presidents not until after one full term (two years). All terms are one year except those of the vice-presidents. No meeting except the annual meeting can approve expenditures or appropriations. The regular meetings are to be the annual meeting in October; meetings in January and May in New York, and in March and September in Chicago; but the executive committee may change the times and places of the last four.

Alternating Current Electric Systems for Heavy Railroad Service.*

BY B. G. LAMME.

In attempting to solve any new and difficult problem in the engineering field it is natural that it should be first attacked with methods and tools already at hand. The results obtained in this manner are in many cases as good as could be expected, but it is usually found that afterward new methods and tools are developed especially adapted for obtaining the best results.

In the problem of heavy electric traction the method of procedure has been very much the same as in other engineering undertakings. The first and most natural means used was that which had shown such remarkable results in light traction work, namely, the direct current system. In the application of this to heavy work, however, the necessities of the problem led to the development of a number of adjuncts, such as the rotary converter or motor generator sub-station for transforming from alternating to direct current, the use of the third rail instead of the overhead trolley on account of difficulty in collecting current, and other features of lesser importance.

As the purely direct current system developed, both in the extent of territory covered and in the size of the equipments handled, it soon became evident that the usual 550 volts was not sufficient for transmission to any great distance if much power was to be transmitted, or large equipments were to be handled. This led naturally to the transmission of the power at high voltage as alternating current, with sub-stations at suitable points for transforming to direct current for the trolley system. In this way one of the first serious limitations of the D. C. system was apparently removed, but at the expense of moving machinery of a capacity practically equal to the total car service, this machinery performing practically no other function than merely to transform from one kind of current to another. Furthermore, the transformation in these sub-stations is a two-fold, and sometimes a three-fold, one. If, for instance, rotary converters are used, the high tension alternating current voltage is first transformed to low tension in the "step down" or lowering transformers. The current at low tension is then fed into the rotary converter and is transformed to direct current. Part of the energy of the alternating current circuit passes directly into the direct current circuit, while part is transformed into mechanical energy, and is then converted into direct current energy, except that part required for overcoming the friction and certain other losses in the machine. In the case of a motor generator the energy of the alternating circuit is all transformed to mechanical energy by the motor. Mechanical power is transmitted to the generator through the shaft, and is transformed to direct current energy in the generator. Necessarily not all the alternating current energy can thus be transformed, for each change exacts its price or commission.

Further, if the alternating transmission voltage is very high, then in the case of the motor generator method it may be necessary to transform or "step down" the line voltage to a voltage suitable for the motor. This means three energy transformations in this case. However, the loss in transforming from the higher to lower alternating voltage does not involve much additional waste of energy, for the alternating voltage transformer, in general, is the most efficient known method of transforming energy, as but 2 per cent. to 3 per cent. is lost in well-designed apparatus.

On the other hand, transformation of energy by rotating machinery is much less efficient, and change from electrical to mechanical form, or the reverse, is generally less efficient than transforming directly from one electrical form to another. This indicates, in a general way, why a rotary converter sub-station has been given preference over the motor generator method in a majority of cases.

After the sub-station adjunct was developed the way seemed to be clear for a while, but as the size of the car equipments was increased it was found that another difficulty had been encountered, namely, the limited amount of current which could be taken from the overhead trolley wire. This determined the amount of power which could be delivered to the apparatus on the car. This led to the development of the present well-known third-rail system, which has been used very extensively where the power consumption for individual direct current equipments has been very heavy.

Even with the above two vital modifications of the direct current system, it is found, as heavy railway conditions are approached, that one of the weakest links in the system is the voltage drop between the transforming sub-stations and the car or locomotive. This is due primarily to the enormous currents which must be handled wtih the usual 550 to 650-volt direct current system. Suggestions have been made by prominent engineers that this difficulty should be overcome by increasing the direct current voltage to 1,000 or 1,500 volts. However, this solution has not been pushed extensively by the principal manufacturers of electric apparatus, as it is felt that this would be only a partial step in the solution of the problem, like the transforming sub-station and the third rail, and also because there are certain inherent tendencies for trouble in the present 600-volt apparatus, which would be greatly exaggerated at much higher voltages.

While the above development was being carried on, the problem was being considered in other ways. Many engineers objected to the third rail for general use, believing that a live conductor should not be located so near the ground, and that the place for the trolley wire is overhead. Recognizing that high voltage for transmission is necessary, but that, after transformation to direct current, there remains the difficulty of collecting large currents from an overhead wire, it occurred to many that a more suitable solution of the problem could be obtained by supplying the high voltage alternating current directly to the trolley wire and then utilizing it, either directly or indirectly, for propulsion of the car or locomotive.

PORTABLE SUB-STATION SYSTEM.

Keeping in view the above trend of direct current development, the most evident of such methods would be to put the rotary converters or motor generator sub-station on the locomotive itself. However, as the ordinary electric car, even of large size, has practically no place for such a transforming sub-station, this method has not been given serious consideration for such equipment. However, in the case of heavy locomotives it becomes a possible one. In theory it presents some very good points, but in practice a considerable objection is found in the size, weight and cost of the sub-station which must be carried by the locomotive. It has been suggested that this sub-station be placed upon a tender equivalent to the present tender of a locomotive, and it has also been proposed that it be placed directly on the locomotive itself.

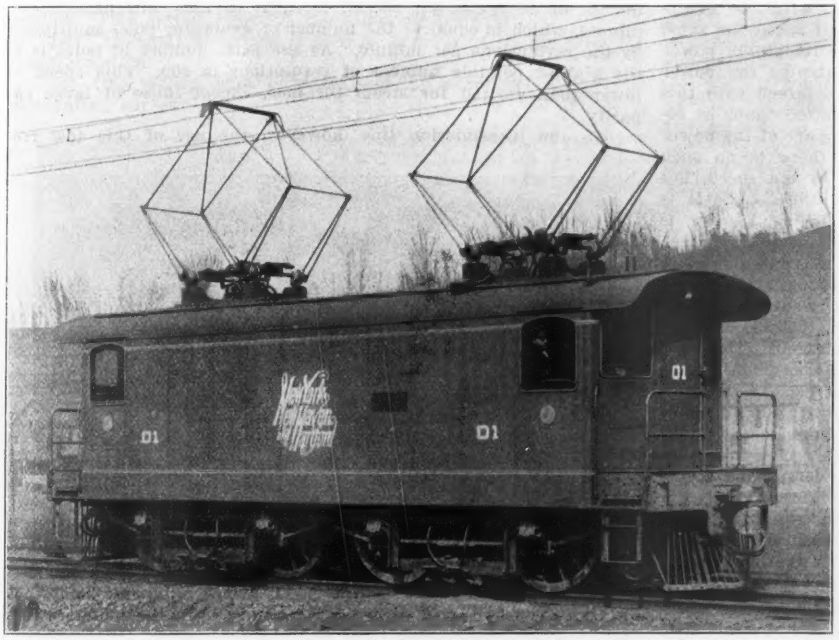
The type of sub-station which is feasible on a locomotive or tender is much more limited than in the case of a stationary substation. For simplicity there should be but one overhead wire,

*From a paper presented before the New York Railroad Club, March 16, 1906.

and therefore the supply system should be single-phase alternating current. This practically limits the transforming equipment to a single-phase motor generator unit. There are two types of single-phase motors having suitable speed characteristics for driving the generator, namely, the synchronous type and the induction or non-synchronous type. The synchronous type must hold rigidly in step with the frequency of the supply system, and when carrying heavy load it can be thrown out of step by a momentary break in the supply circuit. As such breaks are not uncommon in railway service, this type of motor is considered unsuitable. There remains, then, the single-phase induction type motor for driving the generator.

Assuming, therefore, the use of a single-phase induction motor for driving the generator, it should be wound preferably for the full trolley voltage in order to avoid the additional weight of a step down transformer. This motor must have a capacity sufficient for the maximum power of the locomotive, plus all the electrical and mechanical losses other than those in the motor itself. It is self-evident that in order to reduce the weight of the motor as much as possible, it must be run at very high speed.

It may be well to look a little closer into this motor generator transforming set. Considering, first, the motor, it may be said that the single-phase induction type motor in its simple form is one of the least effective types of electric machines which we have. It is non-starting, or starts very uneconomically as a distorted polyphase motor. Its power factor, or the ratio of its true power to the apparent power supplied it or the current and volts supplied, is not nearly as good as that of a polyphase motor of the same dimensions. Its output is only about half that of a good polyphase motor built on the same frame. It is, therefore, heavy in proportion to its output. It takes a fairly large current from the line at no load. On account of its poor starting characteristics, it would preferably be kept running when the power is shut off from the car motors, and it would, therefore, take considerable current from the line when the locomotive proper is running empty, or is at a standstill for a short time. On account of its magnetic losses and the high speed at which it should be operated, this motor would have appreciable losses, even when running empty, and would, therefore, be drawing energy from the line when the locomotive is coasting or is at a standstill. On a 25-cycle alternating system such a motor could be built with two poles for 1,500 r. p. m., or with four poles for 750 r. p. m., the number of poles necessary being a multiple of two. The lower speed machine would be somewhat heavier than the higher speed one, but its losses when running empty would probably be no greater, and could even be less.



New York, New Haven & Hartford A. C.—D. C. Locomotive.

Taking up next the direct current generator driven by the above motor, it is seen from the above that it will be run at either 1,500 r. p. m., or at 750 r. p. m., corresponding to the above motor speeds as it would preferably be direct driven. The higher speed generator, being the lighter one, would naturally be chosen if this speed is not too high to permit the construction of a first-class generator of the required output. Taking, for instance, an electric locomotive of the above type, and corresponding in capacity to those being built for the New York, New Haven & Hartford Railroad, it would be necessary at times that the generator deliver an output of 1,500 kilowatts (2,000 h. p.) or more. Moreover, the load fluctuations would be violent and, therefore, a machine of first-class commutating ability is required. I do not consider that any direct current machine now built, with the above capacity and with a speed of 1,500 r. p. m. is sufficiently good for such service. This, therefore, implies a generator of questionable characteristics, or the choice of a speed of 750 r. p. m. At this lower speed the size of motor generator of the above capacity may be too great to be placed on the locomotive itself, although the weight and cost may not be much greater than for the higher speed unit.

For the purpose of comparison motor generator units corresponding to the above New Haven locomotive conditions were worked out some time ago. The approximate results are as follows, both for the 1,500 r. p. m. and 750 r. p. m. outfits:

Speed	1,500 r.p.m.	750 r.p.m.
Approximate weight	47,000 lbs.	54,000 lbs.
No. load losses	65 h. p.	65 h. p.
Combined effi., at 750 K. W.*	90 per cent.	90 per cent.
Loss at 750 K. W...........	110 h. p.	110 h. p.

*1,000 h. p.

The above weights include starting apparatus, exciter, etc., but do not include the massive base plate which is usual with stationary motor generator sets, as it is assumed that the frame of the locomotive could be made stiff enough to serve for the base. The locomotive structure might require some additional weight, which should also be charged against the portable sub-station outfit.

However, the 1,500 r.p.m. unit was not considered a practicable outfit, from the operating standpoint.

Assuming, however, that such a motor generator set could be used it would permit some very neat features as regards operation of the locomotive. In case it is to be on an alternating current trolley circuit exclusively, so that the motor generator set is always used, then the ordinary direct current control apparatus can be almost entirely eliminated, for the speed of the car motors can be controlled by varying the direct current voltage delivered by the motor generator in the manner proposed by Leonard, namely, by varying the field excitation of the generator. In this way any speed within the range of the apparatus may be obtained efficiently, as there are no armature rheostatic losses and the power supplied is practically in proportion to the load. However, with this method of control a separate exciter is required for the D. C. generator, as a self-exciting machine could not be controlled over a sufficiently wide range.

If, however, the equipment must operate on both alternating and direct current as in the case of New Haven electric locomotives, then a complete complement of D. C. controlling apparatus must also be used, as the motor generator will be out of service when the locomotive is on the D. C. trolley.

In addition to the efficiency of speed control, this motor generator scheme possesses another feature which may be of value in special cases. This is its ability to feed energy back into the high voltage A. C. line by suitably exciting and controlling the car motors so that they can be made to operate in a stable manner as generators of power, such power being fed into the motor generator set and transformed and returned to the line, minus the usual commission, of course. This may be of considerable advantage in letting trains down long grades. In ordinary braking, however, it is a question whether it is worth the complication, as it means that special provision must be made for exciting and regulating the fields of the car motors.

In general, it may be said that the disadvantages of the motor generator scheme are found in the size, weight and cost of the apparatus and the relatively high continuous losses; also, there are objections, from the mechanical standpoint, to carrying a motor generator operating at high speed. The advantages of this scheme lie in the efficient speed variation, simplified control and the ability to return energy to the high voltage line, however, at the price of additional complication.

THE POLYPHASE SYSTEM.

Another method of solving this railway problem, based on using existing methods and means, is that in which the well-known polyphase alternating motor is used. The polyphase induction motor has long been used in stationary work in connection with high voltage transmission circuits. At first glance, it would appear as if this motor should also furnish a solution of the railway problem where high trolley voltage is required. Many of the manufacturers of electric railway apparatus have given this method care-

ful study, and a number have even given it a commercial test on a more or less extended scale. Some of those manufacturers who at first advocated it have since dropped it, while others, particularly the Ganz Company, of Budapest, are still very favorable to it.

Various reasons are given for the attitude of those who have discarded or who have not adopted this system. The most obvious of these reasons are as follows:

At least two overhead trolley wires.

The constant speed characteristics of the induction type motor, preventing efficient speed variation.

General structural features of the induction motor at the usual commercial frequencies.

Taking the first point, it may be said that the use of two overhead wires with a high difference of potential between them is considered very objectionable by many engineers. Those advocating this system have usually talked moderate trolley voltages such as 3,300 volts. While higher voltages may be possible there is no question but that the trolley problem becomes increasingly difficult with increased voltage, and the current collecting devices, switches, cross-overs, overhead equipment of the yards, etc., present serious problems.

The constant speed characteristics of the induction type of motor have come in for much criticism when used for railway work. One law of the induction motor is that it requires a given amount of power to develop a given torque or turning effect, regardless of the speed at which it is running. At full speed the power supplied to the motor appears as useful output, with the exception of the losses in the motor itself. At one-half speed the same power applied gives but one-half full output, the remaining power being wasted in heat. At one-tenth speed, nine-tenths the power is wasted. The reduction in speed is, therefore, obtained with this motor in the same way as a corresponding reduction could be obtained with a friction clutch, namely, by wasting part of the power as heat. With an induction motor, therefore, there is no such condition as power consumption in proportion to the speed, but the power consumption is constant, regardless of the speed. It is evident, therefore, that the induction motor, in its usual form, is an inefficient piece of apparatus where the speed must be varied. This difficulty is overcome to a certain extent by using two or more motors arranged in the so-called "cascade" or "tandem" connection. With this connection a part of the power which would be wasted at lower speed in the case of a single motor is, instead, fed into a second motor and utilized to a greater or less extent. However, there is but one speed at which these two motors, connected in tandem, can operate efficiently, and below this speed the power is again wasted. The two motors in tandem act as if a single motor had been geared for lower speed. The result is the same as if one constant speed motor had been used with a high and a low gear, to give two changes in speed. These two speeds correspond to the efficient running conditions. By the addition of a friction clutch for intermediate conditions and the use of gears with two speed ratios with a single motor, we approximate closely the conditions of operation, as regards economy, that would be obtained with two induction motors arranged to be operated singly and in "tandem."

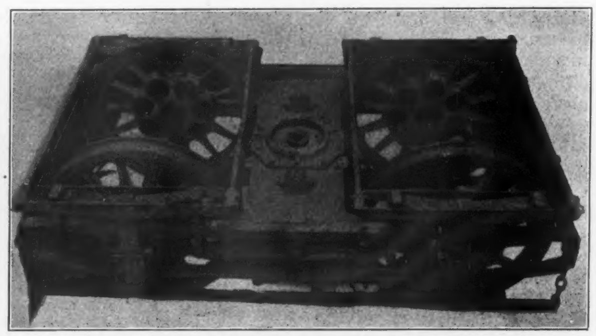
Normally the induction motor, in comparatively large sizes, closely approximates a constant speed between no load and full load. The variation in speed within these limits will usually be less than 2 per cent. Two such motors rigidly connected to the same load must have the same speeds or they will not divide the load equally. Assuming that the normal speed variation in the motor is 2 per cent. and that one pair of car wheels or drivers is 2 per cent. smaller than the other, then one motor will tend to run 2 per cent. faster than the other at all times. They will, however, automatically adjust for equal speeds by unbalancing their loads. At no load one would tend to take half its rated load as a motor and thus drop 1 per cent. below synchronous speed, while the other would tend to raise 1 per cent. above synchronous speed, and carry half load as a generator. The resultant would be equal to no load, but each motor would be carrying half load. Again, at half the rated load of the two motors, one would tend to carry no load and the other full load. In the same way at full load for the two motors, one would carry half load and the other one and one-half loads. The difference in load between the two motors in this case is always equal to that load on one motor which would be required to give a drop in speed equal to the difference in speed between the car wheels or drivers. With 4 per cent. difference between the drivers the unbalancing would correspond to the load required to drop one motor 4 per cent. in speed, or about double load on the basis of a drop of 2 per cent. at full load.

This difficulty can be overcome in a single locomotive by keeping all drivers of the same diameter or by the use of side rods, but this is not feasible when a number of separate locomotives are to drive the same load. When it is borne in mind that the drivers of different locomotives may have as much as 6 per cent. or 7 per cent. difference between the diameters of their drivers it is evident that the unbalancing of the load between two locomotives may amount to much more than their normal rated capacity unless the slip of the drivers equalizes them.

One method of equalizing the loads would be to drop the speed of all of the locomotives to that of the lowest one by connecting suitable resistances into their motor circuits. This would be effective for one given load, but would not give suitable equalization for other loads. For example, with 6 per cent. difference in diameter of drivers of two locomotives, one would tend, when running empty, to carry one and a half times load, receiving power from the line, while the other locomotive coupled to it would carry one and a half times load as a generator feeding back into the line. The use of resistance would lessen this extreme unbalancing but could not eliminate it entirely, as there must be some load on the motors in order that the equalizing resistances may become effective. It is thus evident from the above that only an average equalization of load would be practicable.

Taking up the structural features, it may be said that the induction motor is not particularly well adapted for railway work at the usual frequencies of alternating current circuits, but the reasons for this are somewhat too technical for the scope of this paper. However, the Ganz Company, of Budapest, has avoided, to a greater or less extent, a number of the structural limitations by reducing the frequency of the supply system to 15 cycles per second instead of 25 cycles, the lowest in general commercial service in the country. This low frequency presents no particular disadvantages at the generator station except in the case of small steam turbines, which can have a maximum speed of only 900 r. p. m. The frequency of 15 cycles per second is equal to 1,800 alternations per minute, which is equal to the number of generator poles multiplied by the revolutions per minute. As the least number of poles is 2, the highest possible number of revolutions is 900. This speed is lower than desired for steam turbines, except those of large capacity.

In the transmission line, however, the use of this low frequency in itself is advantageous, as it gives less line drop and loss than with 25 cycles. All transformers, however, become somewhat heavier. The real gain with this frequency, is in the motor, which can be given better proportions and characteristics.



New Haven Locomotive—One of the Trucks.

Among the advantages claimed for this system is its ability to return power to the line under certain conditions. When the induction motor is run above its synchronous speed it acts as a generator and returns power to the line. If a car equipped with such motors be started down grade with the power on, it will speed up until the motors run above the synchronous speed. Below synchronous speed the induction motor acts as a motor. At synchronous speed it does no work. Above synchronous speed it acts as a generator, but it cannot deliver power efficiently, except when running but slightly above synchronous speed. If it is desired to run much above synchronous speed, then resistance must be connected in circuit just as in the case of the motor when running much below speed and the efficiency in returning power to the line is affected by the rheostat in the same way as its efficiency as a motor is affected by the use of resistance. When running 50 per cent. above synchronism, a considerable amount of power is wasted, just as when running 50 per cent. below speed.

In this and in the preceding cases where mention has been made in regard to returning power to the line, it must be kept in mind that there must be some load connected to the line which can absorb this power. A single locomotive on the line cannot return power advantageously because there is no load except the normal light load losses in the line and transformers. Therefore, the return of energy would possess no particular advantages as the practical way to get the additional load would be to connect a rheostat across the line and thus waste the power returned to the line. However, in a system where there would always be a number of locomotives in operation with a considerable portion of them taking power from the line, there would be some advantage in restoring power.

ARNOLD'S ELECTRO-PNEUMATIC SYSTEM.

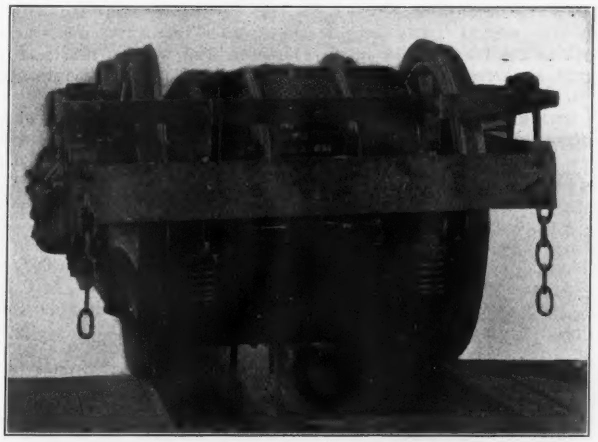
Another method of solving this railway problem with high voltage trolley was that proposed and tried by Mr. B. J. Arnold. He recognized at an early period the advantages that could be obtained with high voltage and a single trolley wire, and he, therefore, adopted single-phase alternating current for his supply system. However, it was again attempted to carry out the work with tools at hand, and the only motor available at that time for use on his single-phase trolley system was the single-phase induction motor. As already mentioned in connection with the motor generator method, this motor has very bad characteristics in regard to starting, overload capacity, etc., and Mr. Arnold, therefore, proposed to supplement the single-phase motor with certain compressed air appliances which would furnish the characteristics lacking in the motor itself. The motor was intended to run at or near its normal load most of the time, while the air apparatus was to do the starting and was to assist in taking care of abnormal conditions. Variable speed operation was also to be obtained by means of the air apparatus. This system differs from the preceding ones, and one notable feature was that the electrical apparatus was in reality a minor feature of the scheme, many of the desired locomotive characteristics being obtained by mechanical means, as distinguished from electrical.

SINGLE-PHASE SYSTEM.

By this time the problem was becoming better understood and at this stage another system was brought forward which was specifically designed to meet the varied conditions of heavy traction service. This system contains the following features:

1st. Alternating current is used on account of its facilities for transformation.

2d. One trolley wire only is used, by adopting single-phase alternating current.



Truck, Showing Motors in Place.

3d. With alternating current and one trolley wire only, any desirable voltage can be used on the trolley line.

4th. By using alternating current an efficient means for varying the voltage to the motors is obtained. With single-phase there is one only supply circuit to be handled, and the variable voltage apparatus can be given the simplest and most efficient form.

5th. A type of motor was developed which can have its speed varied by varying the voltage supplied to it, and which uses power practically in proportion to the load, when operated in connection with the above variable voltage supply circuit.

6th. The motor is preferably wound for low voltage and the same transformer which is used for stepping down from the trolley voltage to the motor voltage can also be used for obtaining the desired voltage variation, for varying the speed, and the power in proportion to the speed.

7th. The motor is inherently of a variable speed type and can automatically adjust its speed to that of other motors driving the same load, with but very small unbalancing of the loads on the individual motors.

8th. The type of motor developed is one which can be used on direct current also.

The above covers the principal features of what is now known as the single-phase railway system. It may be noted that most of these appear in one form or another in the preceding systems, which have been described. It is intended to cover practically all the best features of the other systems. It is, in fact, a tool especially designed to do a particular piece of work, and is not primarily an adaptation of existing apparatus to a new condition. The single-phase system may be described briefly as follows:

Single-phase alternating current is fed either directly from the power house into the trolley line, or from a high-voltage transmission circuit by step-down transformers, into the trolley system. A high-voltage trolley current is carried into the car or locomotive and is stepped down to a suitable voltage to be applied directly to the motors themselves. At the same time the step-down transformer is provided with variable voltage connections whereby the voltage supplied to the motor can be varied up or down over any desired range. The type of motor used is one in which the speed varies directly as the voltage applied to it is varied. Speed control is thus obtained without wasting energy other than that in the motor itself. It, therefore, permits efficient speed control over any range desired by simply varying the voltage over the necessary range. There is but one transformation of energy between the high-voltage trolley wire and the motors which is that of the step-down transformer, and as stated before, the alternating voltage transformer is our most efficient device for transforming energy. At the same time this transformer serves the double purpose of transformation and regulation, as mentioned above.

This method of varying the speed by varying the voltage supplied to the motor is not limited to this particular type of motor, for the ordinary D. C. railway motor can have its speed varied in the same manner. However, with direct current, no simple means has yet been devised for varying the voltage efficiently.

The control of the speed and power by varying the voltage may be roughly compared with the control of a steam locomotive by varying the steam pressure. Throttling varies the pressure applied at the cylinders and thus varies the speed and power. However, the equivalent of the variable cut off is not found in the motor, but it may be said that voltage control in the motor is the equivalent of combined throttling and variable cut off in the steam engine.

There are several variations in the types of single-phase motors used by the different manufacturers, but the principal features of the system are common to all. In its characteristics of variable speed over any desired range, and consumption of power in proportion to the load, the single-phase equipment is on much the same footing as the steam locomotive, as just indicated above. The equipment also possesses the ability to operate at increased speed by increasing the voltage above the normal and can thus make up for lost time, when desired.

As mentioned before, it is important that under certain conditions an electric locomotive should be able to act as a brake, or to return energy to the line, as when taking loads down grade, for instance. There is but one way in which the car equipment can act as a brake, namely, by reversing the function of the motors and converting them into generators of power, the driving power being furnished by the train in movement. In acting as generators there are two ways in which an electric equipment can expand its power: First, by wasting it in resistance as heat, and, second, by feeding it back into the line in case there is any other load on the line which can absorb the power.

The motors of the single-phase system can readily meet the first of these conditions, namely, that of feeding power into a resistance. As the motors are of the commutator type, and are, in reality, first-class direct-current machines, they will readily pick up as D. C. generators and can feed power into a suitably proportioned resistance. This method of braking is perfectly feasible, provided the controlling apparatus and car circuits are arranged for this purpose.

Consider, next, the case of feeding power back into the line and controlling it. It would appear when looking at the problem broadly, that a motor which could have its speed and power varied so economically over a wide range, should also be capable of reversing its functions and becoming a generator of power with an economical control over a wide speed range; and it has been determined in an extended series of shop tests, that the single-phase type of railway motor does possess this property under certain conditions. A number of ways of doing this in a more or less successful manner have been tried. Some of these methods are very effective, and permit practically perfect control of the power and speed during braking, or when returning energy to the line. Such an arrangement would probably not be advisable for merely stopping trains. Its true field would be in letting a train down a grade of such length that the power is returned to the line for a long enough period to represent a fair proportion of the total time of operation. Both this method and that where the power is absorbed in a rheostat, are valuable in relieving the wear of the brake shoes, which is a very important item on very long grades.

The resistance method of braking, although not as efficient as the other, has one advantage, in that it is independent of the supply system. Therefore, in case the power goes off when the train is descending a grade the resistance method of braking would still be effective.

In the past few months two contracts have been taken by the Westinghouse Electric & Manufacturing Company for single-phase railway equipment involving locomotives of steam railway size. These are for the equipment of part of the New York, New Haven & Hartford Railway system and for the electrification of the St. Clair

or Sarnia tunnel, under the Detroit river, on the Grand Trunk Railway. The former equipment will operate under high speed passenger service conditions, while the latter approximates freight locomotive conditions. A brief description of these two proposed installations may be of interest.

THE NEW HAVEN SINGLE-PHASE EQUIPMENT.

In this case the problem is somewhat complicated by the fact that the locomotives must operate on direct current over the New York Central part of the New Haven system, and on alternating current on its own part of the line. However, this complication is not nearly as great as would appear at first thought, for the type of locomotive chosen is one which adapts itself well to both classes of service. However, there is necessarily some duplication of parts on the locomotive, such as the collecting devices, certain details of the controllers, wiring, etc. On the other hand, it is surprising how many parts are common to both classes of service.

As 11,000 volts will be applied directly to an overhead trolley and as the trolley system will span from four to six tracks, it is evident that a very substantial overhead construction must be used. The construction of this overhead system is one of the most interesting features in this whole electrical system.

The trolley system is to be suspended from steel bridges which span from four to six tracks normally, and even a greater number at special points. These bridges are placed at intervals of about 300 feet, and at points about two miles apart heavier structures, called anchor bridges, are placed.

The steel cables which support the trolley wire proper are supported by massive insulators on the bridges. Two cables are used for each wire, and form a double catenary suspension carrying the trolley wire by means of triangular supports. The double system of suspension gives increased stiffness to the trolley construction. The triangular supports are placed about 10 ft. apart. The steel cables have a total sag of about 6 ft., while the trolley wire itself is maintained in a practically horizontal position.

At points corresponding to the anchor bridges, that is, about two miles apart, each trolley wire is broken by section insulators and is connected to the other trolley wires and to two feeder wires through automatic circuit breakers. Otherwise each trolley wire, with its cables and supports, is insulated from the adjacent wires. In this way each wire is sectioned and a short circuit on any one section can cut it out without putting the neighboring wires out of service. The two feeder wires just mentioned are carried the whole length of the alternating system, and by means of these and the arrangement of automatic switches, any entire section of four or more trolleys could be cut out of service and the sections beyond can be kept in service.

The trolley wire has a nominal height of 22 ft. above the track. This height will vary a few inches up or down with wide variations in temperature. The pantagraph type of trolley used on the locomotives has an effective range of about 8½ ft. and therefore a very considerable variation in the height of trolley is permissible.

The overhead system is designed to be amply safe under abnormal conditions, such as high wind or heavy coating of ice. The stresses in the supporting cables with a load of ice ½ in. thick or 1 in. total, each side, on the cables, hangers, etc., will be about 1/6 of the ultimate. The stresses in the structure due to wind have been figured on a basis of 16 2/3 lbs. per square foot, projected surface for the cables and 25 lbs. per square foot normal surface for flat surfaces. This is on a basis of the cables being covered with ice as given above. Allowance is made for double these pressures in summer when there is higher wind velocities, but under this condition the cables will be of much smaller diameter in the absence of ice.

As 11,000 volts is used on the trolley system, no transforming stations are necessary on the part which is now to be installed. The high voltage trolley system will extend about 19 miles in one direction from the power house and about three miles in the opposite direction to Stamford. This system could be extended in the latter direction approximately 20 miles further, if desired, without transforming sub-stations. Therefore, about 40 miles of the trolley system can be supplied directly from the main power house. With a locomotive load representing 4,000 k.w. about 19 miles from the power house and a corresponding load 15 miles away, or four miles from the power house, the drop at the end of the line will be about 13 per cent. This drop is on the basis of feeding into the load from one direction only. If there were a transforming sub-station about 40 miles away from the power house, feeding into the same trolley system, then the drop at a point 20 miles away would not be 13 per cent. but would be considerably less, as power would be supplied from both directions. It is apparent, therefore, that with sub-stations along the line feeding into a common trolley system, such sub-stations could be possibly 60 miles apart. For example, if a transforming sub-station were placed in New Haven about 40 miles away from the power house, the drop at the midway point between the sub-station and power house would be equivalent to a load on the present system at 10 to 15 miles from the power house. However, the above distances between sub-stations are so great that it might prove inadvisable to feed more than one or two sub-stations from a given plant, two or more power plants being installed on a very long system.

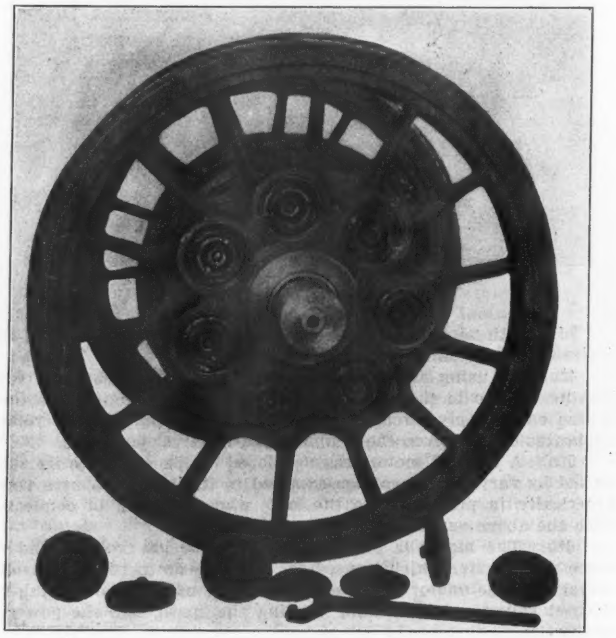
THE LOCOMOTIVE.

This is the part of the electrical equipment which will doubtless excite the most interest, principally because it is a newcomer in an old field. From the standpoint of the designer the generating system and overhead construction may present just as interesting features, but to the layman in the electrical field there is but little with which to make comparison; but when it comes to the locomotive the general problem is much better understood.

The frame, trucks and cab of this locomotive were built by the Baldwin Locomotive Company, on designs developed after many conferences between the New Haven Railway Company, the Baldwin Locomotive Company and the Westinghouse Electric and Manufacturing Company. The design adopted was partially determined by the fact that the motor equipment must be suitable for use on both alternating and direct current. This to a certain extent controlled the number and size of the motors and thus affected the construction of the trucks and other parts. The results have turned out so well, however, that there is every reason to believe that this type of locomotive will be used in future even where alternating current alone is used.

The mechanical construction of the locomotive presents many novel and interesting features which deserve special consideration. The running gear consists of two trucks, each mounted on four 62-in. driving wheels. The length of wheelbase is 8 ft. The side frames are of forged steel and to them are bolted and riveted the pressed steel bolster carrying the center plate. The weight on the journal boxes is carried by semi-elliptic springs with auxiliary coiled springs under the ends of the equalizer bars, to assist in restoring equilibrium. The bolsters are 30 in. wide at the center plate, and are widened, where bolted to the side frames, to nearly double this amount, thus giving a very strong construction without excessive weight. The center plate which transmits the tractive effort to the frame is 18 in. in diameter, and will be lubricated to permit a perfectly free motion in curving. The truck centers are 14 ft. 6 in. apart.

Owing to the fact that the entire space between the wheels is occupied by the motors, it was impossible to transmit the draw-



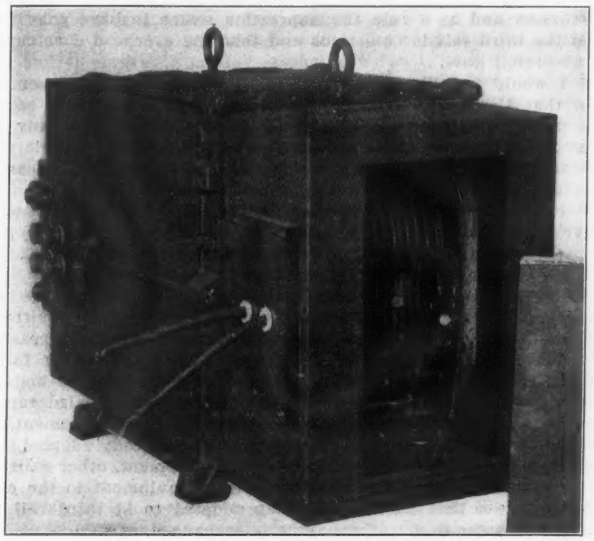
Driving Wheel With Caps Removed to Show Pockets for Driving Pins on Quill.

bar pull through the center line of the locomotive in the usual way. Instead of this, strong plate girders heavily cross braced are carried outside of the wheels and the entire strain of the drawbar is carried to these through strong box girders having top and bottom plates 42 in. wide. Directly underneath the girder at each end is a Westinghouse Friction Draft gear to which the drawbar is attached. The entire design lends itself to a very strong construction without great weight. The cab is built up of sheet steel on a framework of "Z" bars. The apparatus inside the cab is carried on a framework of structural steel which is built into the cab and firmly anchored to floor and ceiling. Over each motor is a large trap door which permits easy access to motor bearings, brushes, etc.

The motors are four in number, each of 250 h.p. nominal

capacity, but with a continuous capacity of over 200 h.p. each, or over 800 h.p. total. The motors are of the gearless type, and are wound for a normal full load speed of about 225 r.p.m. They are connected permanently in pairs and require about 450 volts at the terminals on alternating current and 550 to 600 volts on direct current.

The frame and field of each motor are split horizontally, and can be removed in halves in order to give access to the inside of the field or to the armature. The armature is not placed directly on a shaft, but is built up on a quill through which the car axle



New Haven Locomotive—One of the Two Step-Down Transformers.

passes with about 5/8 in. clearance all around. On this quill, at each end, are placed bearings which carry the field frame.

At each end of the quill is a flange from which projects seven round pins, parallel to the shaft, into corresponding pockets in the hub of the wheel. Around each pin is placed a coiled spring wound with the turns progressively eccentric. These springs are contained between two steel bushings, the smaller of which slips over the pin, and the larger fits in the pocket in the wheel. These springs are amply strong to carry the entire weight of the motor, but are normally required to transmit only the torque of the motor and to keep the motor axis parallel to the axle. They allow a total vertical movement of about ¾ in. The end play of the motor, instead of coming directly on the wheels, is taken by strong coiled springs inside of the driving pins which press against covers in the outer ends of the spring pockets in the wheels. The torque on the motor frame is taken by heavy parallel rods which anchor the frame to the truck above and below the axle. These rods permit vertical or side motion of the motor, but prevent excessive bumping strains from coming on the motor-driving spring. The entire weight of the motor is normally carried on springs supported from a steel frame surrounding the motor and resting on the journal boxes.

The motors are internally of the same general type which the Westinghouse company has been building for some time for interurban service. However, due to the relatively low speed of the motors, the maximum commutator speed is very low, being less than 3,000 ft. per minute when the locomotive is making 60 miles per hour. This may be compared with 5,000 to 7,000 ft. commutator speeds which are frequently attained in both D. C. and A. C. high-speed service with fairly large motors.

One interesting feature in these motors is the method of cooling. As a blower is used in the locomotive for cooling the lower transformers, it was decided to extend this method of cooling to the motors also. In the floor of the cab is an air conduit of considerable size from which air is piped to each motor. This method of cooling improves the continuous capacity of the motors, as evidenced by the above figures, which show that the continuous rating is almost equal to the one-hour rating. A further very great advantage in this method of cooling lies in the fact that the motors can be kept very clean in this manner, as the inside of the motor is kept under partial pressure at all times, tending to keep out dust and dirt, as all air flow is outward. The air furnished to the motor, being taken from the inside of the cab, can be kept relatively clean and dry.

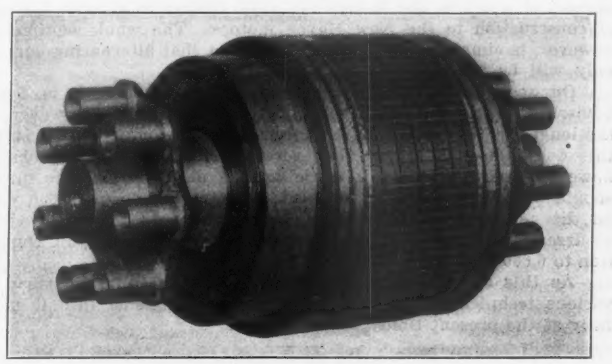
On the direct current part of the line, current is taken from the third-rail system, except in the case of some short sections at cross-overs fed from an overhead trolley on direct current. The motors are controlled in the usual series parallel method in combination with resistance, as in ordinary D. C. practice.

On alternating current the motors are not operated in series parallel as on D. C., but are connected permanently in a given manner and the supply voltage is varied. This gives an equivalent of the series parallel, except that the number of efficient operating steps is much greater. On A. C. operation no resistance is used in regular running, but a slight amount is used in passing from one working step to the next, this being in the nature of a preventive device to diminish the short-circuiting effect when passing from one transformer tap to another. There are six operative voltages, or running points, on the A. C., corresponding to six taps on the lowering transformer, while there are a small number of intermediate steps which are used only in passing from one working point to another. Experience has shown that the number of steps on A. C. required to give a smooth acceleration is considerably smaller than required on D. C. In consequence the controller is so arranged that on A. C. about half as many steps are used as on D. C. The tests have shown that the acceleration on both A. C. and D. C. is very smooth.

There is one feature in the D. C. control which is not generally found at the present time on direct current equipments, namely, shunting the field for higher speeds. On the series position on D. C. the motors have an efficient running point. It is usual railway practice to pass from the series to multiple position by introduction of resistance, there being no intermediate efficient running speed. On the New Haven equipments, however, the type of motor used is one which permits an almost indefinite shunting of the field without affecting the commutation or operation otherwise, and advantage is taken of this to obtain several higher speeds by shunting the fields before passing into multiple. In this way several efficient running points are obtained between the series and multiple. The tests have shown that these motors will operate in a perfectly satisfactory manner on direct current with their fields shunted down to much less than half their normal strength.

When operated on direct current, as stated before, the current is fed directly to the motors. On alternating current, however, step down transformers must be used, as the A. C. trolley voltage is 11,000. The step down transformers are two in number, one on each side of the cab, in order to balance the weight in the cab. It must be borne in mind that these transformers are the heaviest single pieces in the cab and there would be considerable difficulty in placing a single transformer to advantage. A further reason for two transformers is that an injury to one would not entirely disable the locomotive. The transformers are connected in parallel across the high voltage, but on the low voltage side each transformer feeds one pair of motors, through a separate control unit. This means that the controller when operated on A. C. consists of two normally independent units.

The main controllers are of the well-known Westinghouse electro-pneumatic unit switch type. The design, however, differs somewhat from the straight D. C. type, due to the fact that switches, blow-outs, etc., must operate on both alternating and direct current



Armature Complete, With Quill.

as many parts of the controller are common to both. It may be mentioned also that the reversing switches are of the unit switch type.

The main controllers are operated from master controllers at each end of the cab. The controller system is arranged for multiple unit operation so that two or more locomotives may be coupled to the same load.

In addition to the controlling and transforming apparatus there are a number of auxiliary parts, such as two air compressors driven by motors which can be operated on either A. C. or D. C.; two blowers driven by similar motors, for furnishing air to the transformer and motors, and to the D. C. rheostat. It may be mentioned that the air which passes through the transformers is also sent through the rheostats. When operating an A. C. the transformer is heating the air which passes through, and this air would

not be very effective in cooling the rheostat. However, when running on D. C. the transformer is idle, and the air passing through becomes effective in the rheostat.

The locomotive is equipped with devices for collecting both alternating and direct current. For the latter there are eight collecting shoes, four on each side of the locomotive, arranged in pairs of two each. There are, of course, two pairs on each side, one at each end, for the purpose of bridging such gaps as are necessary in the third rail system. There must be shoes on each side, as the locomotive must be able to make contact with the third rail when turned end about. These D. C. contact shoes must also be able to work on two forms of third rail, one in which the shoe runs under the rail and the other where the shoe runs on top of the rail. The locomotive is provided with a pantagraph low tension overhead D. C. trolley to conform with certain New York Central requirements.

For collecting alternating current the locomotive is provided with two pantagraph type high tension bow trolleys. Each trolley has a capacity to carry the total line current under average conditions, but two are provided to insure reserve capacity.

Each of these locomotives is to be able to handle a 200-ton train in local service on a schedule of 26 miles per hour, with stops averaging about two miles apart. In order to make this average speed the maximum speed will be about 45 miles per hour.

One locomotive will also be able to handle a 250-ton train on through service. For heavier trains than this it is intended to couple two locomotives together and operate them in multiple. This presents no difficulties, for, as stated before, the locomotives are fitted up for the multiple unit system of control.

It is evident from the above description that the engineers of the New Haven Railway Company have had in view the adoption of an electric system which is particularly well adapted for future extensions. If the electrification were to stop at Stamford, then the full advantage of the alternating system would not be obtained. However, the section which will be electrified with alternating current is of sufficient length to enable the New Haven Railway engineers to determine the advantages and possibilities for future extension, and it is safe to predict that such extensions will be made in a comparatively short time.

SARNIA TUNNEL.

This equipment is to be on a relatively small scale as compared with the New Haven, as there are to be five locomotives of 750 h.p., which can be operated singly or in multiple as desired. These locomotives are to be of comparatively low speed, developing their rated horse-power at 10 to 12 miles per hour. The service is very intermittent.

On account of the low speed of these locomotives the motors are geared to the axles. As the normal axle speed is about 60 r.p.m., it is impracticable to get a motor of the required capacity into the available space, if made of the gearless type. The motors are therefore designed for a speed of about five times that of the axle.

Except for the fact that they are of the single reduction type instead of gearless, the motors are very similar in general features of construction to the New Haven motors. The whole equipment, however, is simplified somewhat by the fact that alternating current only will be used.

On account of the limited height of the tunnel it is found advisable to use only 3,300 volts on the trolley wire. However, as the length of the electric part of the system is comparatively small, this does not impose any very severe conditions. It is probable, however, that in case the electric zone at either end of the tunnel should be greatly extended, it would be advisable to use 6,600 volts on the additional sections, with transformers on the locomotives, so arranged that they could be switched from a 3,300 volt connection to 6,600 volt connection, or vice versa.

As this system as a whole has been very fully described in various technical journals it is not necessary to go into it more fully at the present time.

DISCUSSION.

Mr. W. J. Wilgus, Vice-President, N. Y. C. & H. R. R. R.—The motives in the minds of steam railroad men when considering a change of motive power from steam to electricity, in the majority of instances, are based upon one or both of the following conditions:

(a) The desire or necessity to abate smoke nuisances in tunnels or terminals in large cities; or

(b) The improvement of passenger service to attract an increased patronage by the public.

In other words, steam railroad companies at the present stage of the development of electricity as a motive power, do not consider its use from motives of economy but from those of necessity or from the broader policy of improving public service. To accomplish these objects, safety, reliability and earning capacity should be borne in mind, as follows:

SAFETY.

Whichever electric system is adopted, full consideration must be given to the question of safety to the employees of the company and to the public. Of decreased dangers from collisions with the use of electricity there is little to be said at this discussion, but increased dangers from working conductors involves the selection between the third rail working conductor with D. C. current, and the overhead construction with A. C. current. Both forms of construction have their disadvantages but, properly installed, neither offer any more cause for apprehension on the part of railroad men or the public than elements of danger that exist with ordinary steam railroad equipment, as for instance, boilers carrying heavy pressures and fires on steam locomotives. As between these two forms of construction, however, there has been more or less heated discussion and as a rule the impression seems to have gone forth that the third rail is dangerous and that the overhead construction is absolutely safe.

I would not like to be considered as condemning either as I feel that there will always be local conditions that will require the use of either or both. I think, however, that it is only fair that the advantages and disadvantages of both should be made plain to those who are contemplating the future change from steam to electricity.

Properly designed and protected, the third rail may be said to have the following disadvantages:

(a) Hindrance to ordinary maintenance of track.

(b) Danger from derailments.

Other objections have been made as, for instance, troubles with snow and sleet, complications at frogs and switches, difficulties of current collection and great danger to employees and trespassers. Extended experiments under my direction have proven the fallacy of these objections, provided the rail is properly designed and protected. Objection has also been made to the use of third rail because of interference with the clearance lines of equipment, but inasmuch as several trunk line railroads have already adopted third rail so as to fix the standard outlines of equipment, other railroads must naturally adjust the outlines of their equipment to the clearance diagram that has already been adopted to fit third rail conditions in order that traffic may be interchanged.

Overhead construction has the following disadvantages:

(a) Inelasticity of construction which prevents the laying of additional tracks or changes of grade and alinement without requiring radical expensive alterations in the permanent overhead structures. For instance, it has recently been necessary in the electrification of about 50 miles of double-track on the West Shore Railroad to decide in favor of third rail because by so doing $400,000 was saved that otherwise must have been spent for the increased cost of the overhead construction designed for anticipated future conditions that might not become necessary for between five and ten years.

(b) Danger to trainmen on the tops of freight cars.

(c) Danger to the public at overhead street and highway bridges.

(d) Danger to trains in tunnels and at other places with restricted clearances, owing to the possibility of rearing cars in cases of collision or derailment making contact with the highly charged conductor.

(e) Danger from derailments knocking down a supporting structure which would affect not only the track upon which the derailment occurs, but also all tracks on, for instance, a four-track railroad, with the possibility of accident to more than one train.

(f) Danger to trains where the overhead conductor carrying, for instance 11,000 volts, is within two or three feet of moving cars. In the city of New York, for instance, the public authorities have even taken a decided stand against wires carrying high voltages on transmission lines remote from the track.

(g) Corrosion due to freight locomotive gases.

On the question of safety it may therefore be concluded that properly designed working conductors, either third rail or overhead, offer as much safety as is now enjoyed with present steam railroad equipment, that both types of working conductors are necessary for the full development of the art, and that as between D. C. systems with third rail and A. C. systems with overhead construction a selection of either may be made to properly fit local conditions, with the preference from a non-electrical standpoint in favor of third rail.

RELIABILITY.

One of the arguments urged by the steam railroad men against the adoption of electricity for heavy railway service is the superior reliability from the fact that the breaking down of one unit still leaves unaffected other units on the system; whereas with electricity, the failure of the power station or line brings all units to a standstill.

To meet this argument it seems imperative that those charged with the responsibility of changing motive power from steam to electricity must reduce to a minimum the chances for a wholesale interruption of traffic. This object can be attained as follows:

(a) Power stations may be constructed in duplicate so that in case of the failure of one the other, by utilizing its overload capacity and spare units, will permit the entire system to be oper-

ated, although possibly with some reduction of efficiency. The New York Central & Hudson River Railroad has adopted the two power station idea, either one of which under above conditions, can operate its system with full efficiency.

The first impulse may be to criticize this policy as expensive, but it should be borne in mind that by so doing the requirement of reliability is obtained, and moreover, as those operating the system become expert in preventing troubles, the surplus power may be utilized for taking care of the expanding traffic of the company. Already we see ahead the necessity for the use of this surplus energy and in the meantime we are amply protected against the usual troubles in starting a new system.

(b) The transmission line should, where possible, be in duplicate, and the working conductor should be such in fact as well as in name and not utilized for transmission purposes. In other words, the working conductor should be sectionalized so that in case of breaks of any kind the trouble will be confined to the section in question, leaving the remainder of the road to be operated without delay to trains. The system described by Mr. Lamme appears to omit a consideration of this feature so that in case of a breakage of the overhead construction not only will the working conductor be out of service at the point of trouble, but the entire system will be at a standstill. In other words, should a derailment or any other occurrence cause the collapse of the supporting members of the overhead construction as proposed by Mr. Lamme, not only will the trolley wires but also the feeder wires be broken and all power will be cut off from trains.

(c) In order to guard against interruption of service batteries have been considered a necessity on trunk line railroads. This has been urged not only by the advocates of D. C. current but by some of those most prominent in the A. C. field, and it is therefore somewhat surprising that those who have been the most urgent in their advocacy of batteries for D. C. installation should now consider them unnecessary where they are advising the use of A. C. current. Certainly conservative railroading on trunk lines carrying frequent passenger, mail and express trains should leave no stone unturned to guard against interruption of traffic and thus meet one of the strongest arguments that has been raised by those believing that steam railroad practice with independent units is far superior to electric traction. If this is conceded, the cost of batteries is just as legitimate a charge against the use of A. C. electric systems for heavy railway service as for the D. C. system, and even more so if but one power station is used as contemplated in the system described by Mr. Lamme. I merely bring out this point in fairness to both systems.

(d) *Locomotives.*—The relative technical advantages of A. C. and D. C. systems for heavy railway service I will leave to those who are far better qualified to discuss them, merely calling attention to the wisdom on the part of the steam railroad men to adopt the system not only best suited to local needs, but, moreover, the one which by long experience or careful experiment is proven to be worthy of adoption in such a revolutionary step as the change from the long tried steam locomotive to electric motive power in districts where a failure would be disastrous. In other words, the responsibility on the steam railroad men of the change from one kind of power to another is sufficiently heavy without adding to it the use of untried systems.

EARNING CAPACITY.

To secure increased earning capacity in making a change from steam to electricity a change must also be made in the operating conditions that by long experience are known to bring about the creation of a new remunerative traffic. We all know that when the change from horse cars to electric cars was first proposed many arguments pro and con were made as to the relative cost of operation and therefore the effect upon earnings. Almost, immediately, however, the question of comparative cost of operation disappeared because it was discovered that the improved conditions, entirely apart from the cost of operation, created enormous increase of traffic that made the advantages from the use of electricity self-evident.

The causes of these benefits alike to the public and to the railroads were:

(a) Increased speed, which was obviously attractive to the public and which increased the capacity of the railroads.

(b) More frequent stops without corresponding loss of speed, because of quicker acceleration.

(c) More frequent units.

When a steam railroad finds it desirable to change its motive power on its through trains which must be handled by locomotives, should it not at the same time follow in the footsteps of urban railroads and adopt the same flexible system of train units for its suburban traffic? By so doing trains made up of a desired number of cars may be run with the frequency best suited to the volume of traffic at different times of the day without in any manner affecting acceleration, which in turn is largely the measure of the capacity of the road. For instance, with the multiple unit system at certain hours of the day trains of three cars will be sufficient, whereas at the rush hours trains a few minutes apart may be made up of as many as 10 or 12 cars.

With multiple unit operation the power of the train is always proportioned to the load and there is therefore a uniform acceleration; whereas with locomotive operation the larger the number of cars the slower the locomotive is in starting. Moreover, in congested terminals the use of multiple unit self-moving cars dispenses with switching, flying movements and duplicate interferences across the throat of the yard.

Therefore the more frequent trains possible with multiple unit operation, quicker acceleration and higher uniform speeds, all combine to make attractive to the public the territory along the railroad adopting that system; whereas a mere change from steam to electric locomotive practice, whether of the A. C. or D. C. system, brings to the railroad none of the increased earning capacity which it should secure when incurring this large expense.

SUMMARY.

Admitting that the purpose of a change of motive power for heavy railroad service from steam to electricity is to abate the smoke nuisance and improve the passenger service so as to make travel more attractive, the electric system that is adopted, whether direct current or alternating current, must employ the safest appliances known to the art, must have all possible safeguards against interruptions due to troubles in the power station and on the line, must employ well tried apparatus that has passed beyond the experimental stage, and must be thoroughly flexible so as to afford the traveling public the advantages that are denied with steam operation. The use of any system which does not possess these qualities will burden the corporation adopting it with a heavy expense, for which there is no adequate return. Whether this system shall be A. C. or D. C. depends entirely on the development of the art from a practical standpoint and the local conditions. The more congested the traffic the more necessary the adoption of the system that will be least in danger of failure and best adapted to public demands.

Washington Correspondence.

WASHINGTON, March 20.—It is becoming apparent that Senator Bailey will not be able to command the support of all the Democratic Senators for his proposition to amend the Hepburn railroad rate bill so as to provide for review by the courts of orders issued by the Commission with a provision restricting the right of the courts to suspend an order pending its review. The break in the Democratic ranks increases the probability that the Senate will adopt a review amendment that will not impose any restrictions on the power of the courts to enjoin the enforcement of an order of the Interstate Commerce Commission pending review with a provision requiring the difference between the challenged rate and that made by the Commission to be deposited in escrow subject to the order of the court on the final determination of the case. Republican Senators who favor such an amendment are confident that it will meet with the approval of President Roosevelt, whose views on the subject of suspension seem to have undergone considerable modification.

The proposition to require the impounding of the amount in controversy rather than to require the roads to give bond for the reimbursement of shippers is favored on the ground that, under a bond provision, it might be necessary for shippers who had paid the old rates pending review to institute suit to recover the amounts due them. On the other hand, if the money is held in escrow subject to the order of the court, it would be paid out in accordance with the directions of the court, and if the order of the Commission should be sustained it would be returned to the shippers who had paid it at once. This proposition is also favored on the ground that it would tend to prevent roads from instituting review proceedings merely for the sake of delay. It is contended that, under such a provision, the officers and attorneys of a railroad would be deterred from filing an application for review unless they were convinced that the order of the Commission was illegal and would be set aside by the court. Otherwise, they would have nothing to gain and would lose the costs of the case in court. It is also argued by the advocates of this proposition that it would tend to reduce the time occupied by review proceedings for the reason that a road instituting such proceedings with the belief that the order was illegal would have a substantial financial interest in having the case decided as soon as possible so that the money impounded subject to the order of the court could be paid into the treasury of the road without delay.

Senator Simmons, of North Carolina, stated more clearly than any other Senator who has yet spoken the real ground on which the advocacy of denying to the courts the right to suspend pending review is based. He argued that the enforcement of the order would work an irreparable wrong either to the railroad or to the complaining shippers, and he preferred to take the chance of injuring the road. This argument is being met by pointing out that the complaining shippers would be fully protected by the deposit

of the amount in controversy in escrow, while, if the order should not be suspended, there would be no way of preventing the possibility of irreparable injury being done to the railroad and to those shippers who would be injured by the change that the order would make in the relation of rates affecting rival communities.

One of the grounds on which it is contended that there should be no restriction of the power of the courts to review the orders of the Commission is that such review is more necessary to prevent the issuance of illegal orders than to correct them after they have been issued. It is contended that the inferior courts of the states and of the United States are made careful and kept free from the suspicion of corruption by the fact that their decisions are subject to review, and it is argued that it is still more important that the administrative orders of a political commission should be subject to review by the courts to prevent the members of that body from undertaking to institute and enforce fantastic theories as to the government of the transportation business of the country by making decisions in accordance with their ideas as to what the law ought to be rather than in accordance with the manifest intention of Congress. The history of the Commission in the past is cited to show that it has been overruled by the courts so frequently for the reason that it has attempted to read into the Interstate Commerce act provisions of law that were not put there by Congress. J. C. W.

Wheeling & Lake Erie Earnings.

The gross earnings of the Wheeling & Lake Erie for the seven months ended Jan. 31, 1906, were $3,350,618, an increase of $709,253; net earnings, $968,735, an increase of $467,993. The surplus after charges was $133,118, which compares with a deficit of $139,945 for the corresponding period of the previous year. Maintenance of equipment and general expenses increased in about the same ratio as gross earnings, while conducting transportation shows less increase and maintenance of way shows a slight decrease. The operating ratio was 71 per cent., a decrease of 10. The average revenue train load increased from 426 tons to 560 tons.

All-Steel Drop Bottom General Service Gondola Car for the Frisco System.

The Frisco System is now receiving a lot of 200 all-steel drop bottom general service gondola cars, 100 for the Chicago & Eastern Illinois and 100 for the Kansas City, Fort Scott & Memphis, which embody a number of new points in design. They might properly be termed a 99 per cent. flat bottom dump car in that, although the floor of the car is flat with the doors closed and is to all appearances an ordinary flat bottom gondola car without hoppers, when the doors are open it will discharge its lading to an even greater extent than 99 per cent. without shoveling. The cars are of 100,000 lbs. capacity and were designed and built by the Pressed Steel Car Co., of Pittsburg.

General Service Drop Bottom Gondola Car—K. C., F. S. & M.

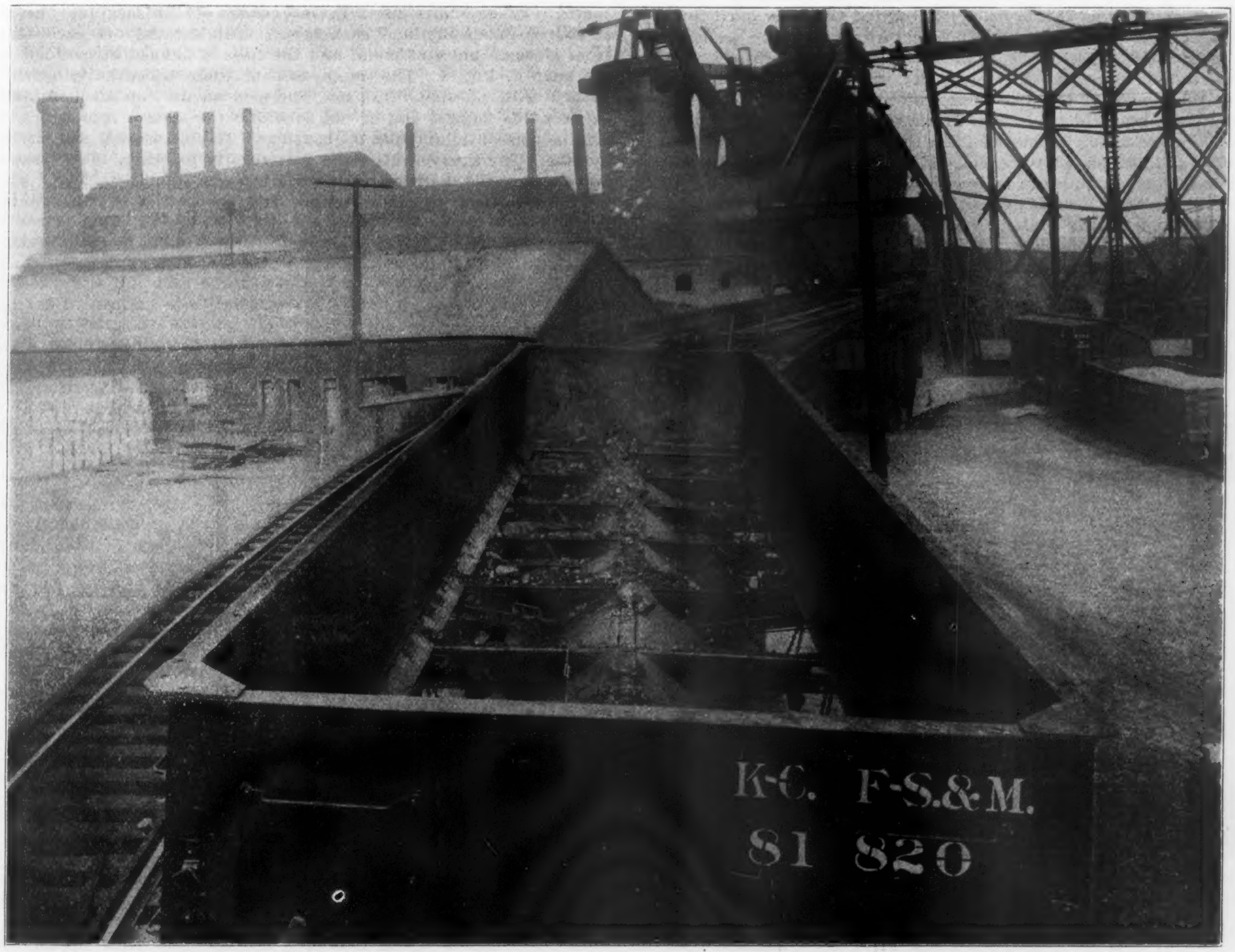
General Service Drop Bottom Gondola Car Discharging Load Through Four Doors.

Through the courtesy of the National Tube Co. a test was made of one of these cars at their works at McKeesport, Pa., on March 7 by officers of the Pressed Steel Car Co., to demonstrate the rapidity with which the car clears itself in dumping, and several photographs were taken which are reproduced in the accompanying engravings.

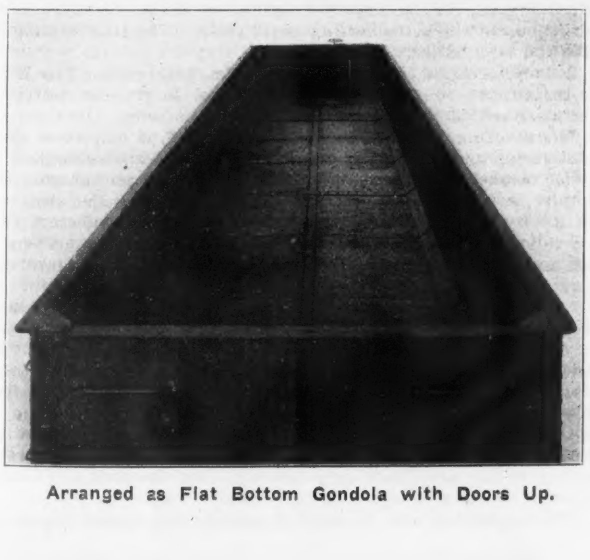
The first of these shows a general view of the car before dumping its load of 99,300 lbs. of run-of-mine coal. This is somewhat less than the capacity of the car level-full and therefore the coal in the car is not visible in the photograph. The second illustration shows the car as one-half of the load is being dumped from the

approach to the ore-trestle of the National Tube Works. The third photograph is an interior view of the car after dumping the whole load, and shows distinctly the self-clearing nature of the car. It will be seen that one end of the car was on a curve, the elevation of which decreased the angle of inclination of two doors immediately over the truck, thus retaining a small portion of the load which would have otherwise dumped. The illustration shows more coal retained at that point than at any other. The car was not weighed after dumping, but it was estimated by several of those present that not over 600 to 700 lbs. of coal remained in the car. It may safely be said, therefore, that not more than 1 per cent. of the load will be retained and the greater portion of this will run out when the car is jarred to any extent, such as the coupling of an engine or slight shifting. The time required for dumping is about six seconds for each half of the car, and the time consumed in closing the doors about one-half minute for each of the four sections. Such a car can be placed, dumped and the doors closed to form a flat bottom gondola car by two workmen in four minutes or less. The fourth illustration shows the interior of these cars with the doors closed.

The car is built entirely of steel and has 16 drop doors so that practically the whole bottom of the car drops. The eight doors over the trucks drop to a clear opening of 23 in., while the eight doors in the center of the car have a 26-in. clear opening. The center sills are pressed to form an inverted V at the top and are rivetted to a T-shape which has a 4-in. top, and are reinforced with angles at the lower edges. The center ridge of the car is only 4 in. wide. The body transoms are built up of plates and angles which give a 7-in. space, while the cross-bearers are of pressed steel shapes and have a top surface only 3 in. wide.



General Service Drop Bottom Gondola Car After Load Was Discharged by Gravity, No Shoveling.



Arranged as Flat Bottom Gondola with Doors Up.

The doors are operated by a so-called "creeping shaft" mechanism which is carried in slots by the cross-bearers and bolsters, and while the doors are closed by chains attached to these shafts, the latter are automatically moved over underneath the doors when fully closed and the load is thus securely supported and accidental discharge is impossible.

The general dimensions of the car are:

Length over end sills	42 ft. 9 in.
Length inside of body	41 " 9 "
Width over stakes	10 " 2 "
Width inside	9 " 6¾ "
Depth of body to top of sides	4 " 4 "
Length of doors in clear	4 " 10 "
Width of doors in clear	4 " 2½ "
Height of floor from top of rail	4 " 5 "
Truck centers	31 " 0 "

The name, general service gondola car, is indicative of the usefulness of a car of this type. It may not only be used for coal, ore, gravel and all kinds of materials that may require dumping either from trestles or to the ground, but on account of its flat features, free of hoppers or any other depression it can be shoveled out without effort where dumping is not feasible. As a flat bottom gondola car it can be used for loading lumber, pipe, bar iron, brick, sewer pipe or any materials of that kind which cannot conveniently be loaded in hopper cars, and this type of car is, therefore, of interest not only to railroads but to shippers.

The "American" Electric Semaphore.

The signal here described has been developed in the past two years, and possesses important merits. The spectacle casting and blade are pulled to the proceed position instead of pushed, as in the ordinary designs. The electric motor is of high electrical efficiency and excellent mechanical design. The shaft is of tool steel, ground to gage; the bearings are of phosphor bronze, needing no lubrication, and the commutator is built exactly like the commutators of large electric generators—of drop forged copper segments, insulated with mica. The whole motor is enclosed and dust proof. The commutator and brushes are protected by a glass covering which can be removed to permit inspection. In the base of the motor, directly back of the name plate, there is a copper pan which can be filled with calcium chloride, or other suitable chemical, or with lime, to absorb any moisture which may collect on the glass, the commutator or the brushes. By filling this pan once in every three or four weeks it is hoped to do away with the trouble now so frequently experienced from frost. From this pan a hole is cored to and under the glass covering, so that the commutator will have the benefit of the absorbent while yet the fumes of the chemical cannot reach or injure the insulation on the armature winding.

This signal can be moved from the stop to the proceed position in 7½ seconds on 10 volts and 2¼ amperes. With eight volts a current of three amperes is required to clear the signal in 10 seconds. The blade can be readily moved from any position that the motor may stop in. The figures just given are computed from the instant the circuit is closed (not, as is customary, when the load is thrown on the motor) and are based on the use of a 90-deg. semaphore casting, counterweighted to raise a 6-lb. weight on the end of a 4-ft. blade. It will be noted that this requires a counterweight of considerable size when depressing the blade to the proceed position. It is possible to operate one blade for two positions, or one blade for three positions; two blades for two positions, or two blades for three positions, all without making any changes other than of the wires leading to the circuit controller. This can be done in 20 minutes.

Figure 1 represents the mechanism equipped with a dash pot *A* to act as a cushion when the arm returns to the stop position, as is the general custom. But as dash pots have peculiarities, the designer has substituted something simpler and more satisfactory, the fan, *B*, shown in Figures 3 and 4. This fan is worked in connection with clutch. It is supported by an independent bearing and causes no friction on the motor shaft. When the motor is engaged by the clutch the fan is disengaged, and vice versa.

The clutch is operated by a solenoid which is in series with the motor. It is enclosed in a watertight iron case, and bolted to the underside of the plate supporting the motor. It acts through the vertical rods seen at each side in Fig. 3 projecting through the base plate.

The blades, when in either the stop or proceed position, are mechanically locked and it is impossible to move them except by operating the mechanism enclosed within the post. The sheave, at the top of the post, carrying the bicycle chain for operating the blade, is supported by the square semaphore shaft, *S*, Fig. 2. The chain is attached to the top part of the quadrant sheave while the blade is at stop. It passes around the sheave, lying in the groove; and thence through a square hole in the lock-dog, *D*, which is provided with rollers to prevent friction between the chain and the dog. As shown in Fig. 2 the lug on this dog is under the lower edge of the sheave and the chain has been forced in toward the semaphore shaft so that it does not hang in a straight line. In this position it will be noted that the blade could not be depressed on account of the lug on this dog. When power is applied to the chain it is drawn taut, and this throws the dog and its lug clear of the sheave. The sheave is then pulled down and the blade brought to the clear or proceed position. This locking device is made to operate in the same way whether the blade is moved to "proceed" by elevating or by depressing the arm.

The sheaves, *c*, Fig. 3, are cast-iron, and fitted on tubular shafts. These shafts meet in the center of the machine but are of course independent of each other. The sheaves are each made from a single piece of metal and the tube is flanged at one end for the gear *d*, Fig. 4. The outer ends of these tubes have bearings bushed with phosphor bronze. There is an oil cup about midway between the flanged end of the tube and the sheave into which oil may be poured to lubricate the bearings. The lubrication will last for months. The sheave, tubes and gear revolve together. Fig. 3 shows two sheaves, the machine being for a two-arm signal.

The vertical phosphor bronze rod connecting the mechanism with the blade is ¼ in. diameter, straight and hard drawn. No guides are required no matter what the length of post, as there is no compression strain and hence no buckling. Should the rod break there can be no improper indication given, as there is no obstruction on which the casting could catch. The tensile strength of the rod is 2,100 lbs.

A bicycle chain connection is used at both ends. The lower one is fastened to a funnel shaped flange to prevent water or moisture reaching the chain.

The covering for the slot magnets *e*, Fig. 3, is to protect them against dripping water. The only moisture that can accumulate on the slot magnets is what may condense from the atmosphere. The armature is not liable to freeze to the slot coils, as the armature with its bar weighs about five pounds, and all the moisture that could collect on these coils would hardly hold that weight. There is about one 200th of an inch clearance between the armature and the cores of the magnets.

With this mechanism the blade can be stopped at any angle and immediately returned to the proceed position, without first returning it to the full stop position. This is a very desirable quality as not infrequently momentary interruptions to the track circuit allow the blade to move toward the stop position. The mechanism can, of course, be used to move the arm either up or down from the horizontal. If a road which is using the downward indication when a signal is installed desires to change, all that is required is the new blade grip casting; then by giving the head casting on the post a half turn the signal is ready for service.

The mechanism can be used to operate two blades separately

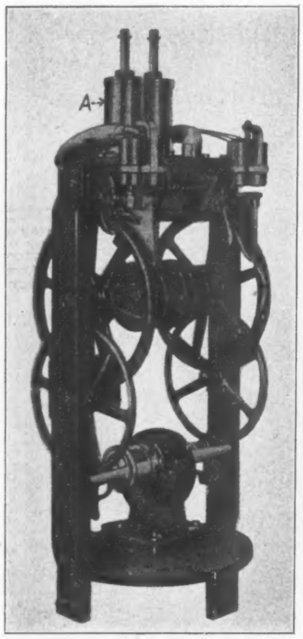


Fig. 1.—Model B.

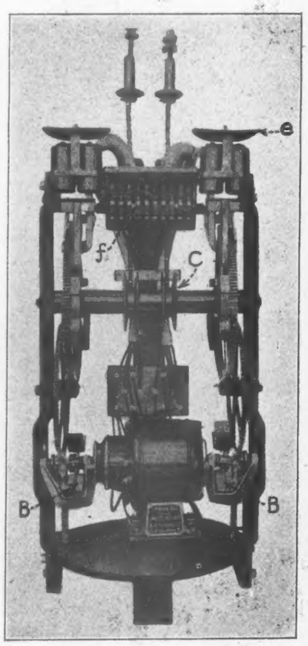


Fig. 3.—Model C.

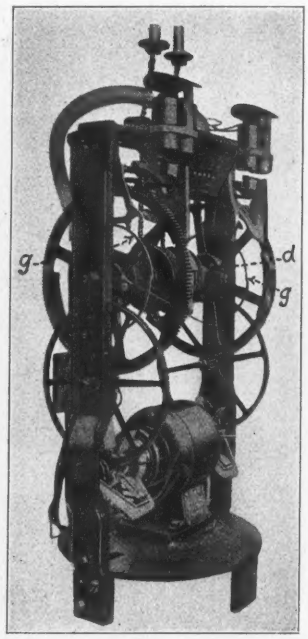


Fig. 4.—Model C.

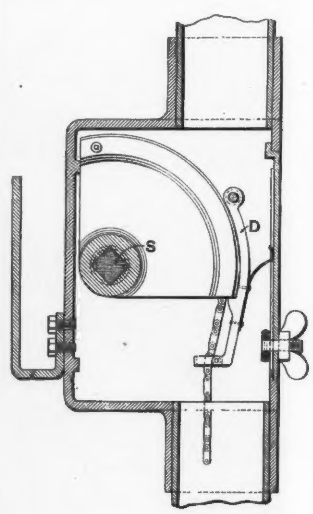


Fig. 2.

Motor and Connections for the Electric Semaphore of the American Railway Signal Company.

or both at the same time, with the same motor. The slot or lock coils can be wound to 800 ohms; and then with 10 volts the signal will at all times be under perfect control, because these coils are at no time required to hold more or less weight than the armature and its bar. The weight of these is sufficient to break away from the coils when a current of five volts or less is used. From this explanation it will be seen that the weight of the blade at no time adds to the work to be done; and there is no necessity of a delicate system of adjustment between these coils and the weighted semaphore. The weight of the armature bar when released from the coil is sufficient to release the signal under the most adverse conditions. It has been known to work successfully with 250 lbs. of added weight, which is many times in excess of any ordinary accumulation of ice or snow.

The circuit controller *f* is enclosed in a water-tight case, keeping the rubbing contacts free from dust and moisture. This controller is operated by a rim *g* on the large bronze gear and the construction and operation are such that at no time can the circuits be shifted except through the operation of the gear. The wires leading from this controller are run through fibre bushings and rubber tubes to a duplicate board from which the lead-out is made. Phosphor bronze is used in all gears. This not only precludes the possibilty of rust, but insures a long life, great strength and little wear; and no oil is needed. All moving parts are bushed with bronze.

Signals of this design have been in use over a year, and one, a two-arm signal, three-position, working each blade separately and independent of each other, has been in operation since the first of November, subject to all kinds of weather, and thus far has not failed. The fan with which the new model (Figs. 3 and 4) is fitted serves to prevent the formation of frost and ice on the gears and moving parts, by keeping the air in circulation. The fan is thus used for two distinct purposes, for enabling the signal to be returned to the stop position without the use of a dash pot, and for circulating the air.

This apparatus is designed and manufactured by the American Railway Signal Company, of Cleveland, Ohio.

Machine Shop Practice.*

Good machine shop practice may be said to be the arriving at the desired result at the lowest cost. Whatever can be done to cheapen production is a step forward. Very much might be said about rules and procedure for maintaining discipline, for the systematizing of output, for the installation of the piece-work system or the many modifications thereto, and many other points; these, however, will be but briefly touched on. Attention will be directed chiefly to the equipment of the shops to indicate how very much can be done in the way of cheapening output.

The general management of a large machine shop is a subject in itself. The control over the shop should be very complete, and as much a one-man control as possible, not that one man should actually supervise the shop but that he should control every department through competent assistants, each assistant or foreman having trusted foreman or sub-foreman under him. The utmost care should be taken to have all the work performed systematically, so that the time lost in handling work is reduced to a minimum. Again, the utmost care should be taken to turn out good work, for in the end any concern doing poor work is doomed to failure; not only should the workmanship be good, but the parts turned out should all be to gage within a predetermined limit of error, the allowable error being determined by means of limit gages.

The general scheme of handling the men, whether by day work, piece work, premium or other systems, is also a subject in itself. Each system has advantages and disadvantages. The men should be under careful supervision, but at the same time not watched as if they were trying to cheat the company. A speed foreman or a man whose duty it is to speed up the tools to the proper point is generally obnoxious to the men unless he has exceptional tact. The work can be done by a sub-foreman without the special title. The good will of the men should, as far as possible, be obtained by making the surroundings comfortable and healthy and paying a good wage to keep good men.

An efficient tool room is a requisite of a good shop. In it the tools should be kept in some good system and should be kept always in the best of condition. The machines in this department should be high class, otherwise their imperfections will be reproduced in the tools. In the larger shops it is the duty of the tool room to not only see that certain tools are on hand for doing the work but to see what jigs or other fixtures could be made to cheapen production, and to consider in general the best way to handle any special job.

The general stores department is of great importance, for on it depends very much the profit or loss that the company will incur. The only possible way to prevent shortage, to reduce stock to a minimum, to keep an exact inventory of material on hand, to make certain that all outgoing material is charged to the right account and to prevent delays in the manufacturing department by having ready to deliver the proper material at the required time, is to create a general store-keeping department for finished and unfinished material in charge of a good general storekeeper and under him a sufficiency of clerks.

General management, tool supply rooms, general stores department, accounting departments are classed as non-productive, though of course without efficient service in these departments no works can pay. But the works themselves, the machines and men doing the actual labor, are where the money comes from, and it is there that the greatest reduction in cost must be made. In general it will be found that as the productiveness of the shops increase the non-productive labor will also increase. The great cost in all shops is the labor. Anything to cut down the relative cost of labor is a step in the direction of greater profit for the manufacturer, not necessarily to cut down the rate of wages, but rather the reverse, but to still further increase the output per man. The means for increasing the output may be taken up under these heads:

1st. Multiplying tools.
2d. Multiplying machines.
3d. Improving the quality of the cutting tool.
4th. Increasing the speed and ease of handling the machines.

"One machine—one tool—one man," was the old rule since the operation of the first machine, and if some shortsighted trades' unions had their way, would still be in force. But such is no longer the case in live machine shops. Many single spindled drills are, for special work, replaced by multiple spindled drills, so that with one operation half a dozen or more holes are drilled, gaining very greatly in time and also in having the output absolutely interchangeable, a point of the very highest value. Single-headed planers are now the exception except in small sizes; planers cutting on both the forward and return stroke have been used but are not generally approved; plate edge planing machines cut both ways with entire satisfaction. Lathes also have multiple cutting tools. With locomotive driving-wheel lathes, for example, the two wheels and the two bearings are in some cases machined simultaneously. Shafting lathes have usually three tools operating, gun lathes, four, etc. Vertical boring mills have usually two heads. Turret lathes in their many modifications are a slightly different example of multiplying tools. The different tools are contained in one machine, but usually one tool operates at a time, the saving in time being effected by the extreme ease of changing from one tool to another. Screw cutting machines with multiple spindles are now universal, so that the price per operation is reduced to a minimum—what a difference between the time when every screw was cut in the lathe or by hand dies and present day practice, when, for example, the operator has to thread 15,000 half-inch bolts in a day to make a living wage, as is the case in a Pittsburg shop! The milling machine is another example of duplicating tools, though in a slightly different sense. The milling cutter may have 20 to 30 cutting edges, each doing its fair share of work and each is as distinctly an individual tool as the cutters in a boring bar, for example. Besides this a milling machine may have several heads. Milling machines have been productive of immense economy in the machine shop, not only in the decrease in time for the operation but also in facilities offered for milling any kind of profile. The multiplying of cutting tools in a machine will always be more of special than general application. The tendency of engineering practice is towards specialization, which is eminently favorable to the multiplication of tools.

Many non-automatic manually controlled machines can be replaced by semi-automatic ones, so that one man can attend to two, three or more of these machines; and, one step farther, many non-automatic or semi-automatic machines can be replaced by automatic ones, for which the only attention required is the intermittent feeding of a new bar from which the screws, nuts, bolts, etc., are automatically turned out. But, in addition, besides the economy in it, there is the advantage of obtaining uniformity of product and greater degree of accuracy. It is quite possible, however, to overstep the mark in installing automatic or semi-automatic machines, especially the former. They are only a paying investment when the number of pieces of one kind is large, so that the time taken to set the mechanism is small compared to the time the machine will be in operation. It is the balancing of capital and interest against saving in attendance.

Hand chipping should be replaced by pneumatic chippers, hand riveting by pneumatic or hydraulic riveters, hand filing by emery wheels or portable electric grinders, portable drills to replace the old ratchet. Planers should be supplemented by milling machines to cut down the number of operations, lathes should be supplemented by grinding machines. Portable tools are usually thought of as being small and light, and the majority of them are, but sometimes the work is so large that it cannot be taken to the machines, and consequently the machine has to be taken to the work, necessitating large and heavy portable planers, drills, etc., such, for example, as were used in the shops of the Westinghouse Electric & Manufacturing Co. at East Pittsburg in machining large

*Paper by G. M. Campbell, read before the Mechanical Section of the Engineers' Society of Western Pennsylvania.

generator frames, some of these frames being laid out by means of a transit, as the ordinary method of straight edge, square and level, were insufficient. In shops producing pieces by the thousand, such, for example, as bicycle factories, sewing machines, standard lathes and a thousand and one small articles of every description, the general practice is to install special machines for every individual operation, with always the result of cheapening cost.

Another imperative addition to all up-to-date machine shops is the traveling crane, which may be considered under the head of multiplying machines. Its value can hardly be overestimated, as the time and the labor saved by its use pays for its installation many times over. Practically all traveling cranes are electrically operated, and they are usually so equipped that there is motion in three planes at once. The use of the electric magnet for lifting in connection with these cranes should be made with reserve. It is, however, of much service in some places where the crane travel is small. Small electric or pneumatic jib cranes or suspended hoists should be installed wherever there is much lifting in one particular spot.

The discovery of the value of certain steel alloys is one of the greatest of the age in regard to machine shop practice. Its value is far-reaching, not only in greatly decreasing the time required for an operation but also in leading machine shop men to investigate all connecting problems, such as the strength and better design of machines, the time required for handling and chucking the work, etc. If, under old conditions, a certain operation in a machine required three hours time and one hour for chucking and handling, the idle time of the machine would be only 25 per cent. of the total, if the time of the operation were reduced by the use of high-speed steels to one hour then the idle time would be 50 per cent., and some endeavor would undoubtedly be made to decrease time of chucking. There is a large amount of literature on the subject of these high speed steels, and some of the showings are little short of marvelous compared with former practice. This is especially the case under favorable conditions in experimental demonstrations. Under ordinary conditions the results are less startling, for the problem is not one of speed alone. High speed steel may not always be a paying investment; for example, a light job requiring relatively little time for cutting compared to time required for preparing and chucking; or, again, suppose, under ordinary conditions, a man has all he can do attending to two machines, the cutting time of one being just sufficient for the chucking time on the other, then any decrease in cutting time would be of small advantage. In general, the new steels cannot be used to the limit, first, because the present machines will not stand it and the general tendency is to retain present tools, working them to the limit instead of at once scrapping them, and, second, much of the work will not stand it on account of special shapes. The old carbon steels give better results, as far as service is concerned, on very light finishing cuts. But on the larger work, shafting, guns, wheel turning, big planing operations, etc., the advantages to be gained by the use of high speed steel are considerable. These steels have increased the output of railroad shop machines 25 to 100 per cent., and in some cases even 200 per cent. There is still considerable experimental data to be obtained before the best results are obtainable from these steels, as the speed bears some relation to the depth of cut and the feed. The highest speed does not necessarily remove the greatest amount of metal in a given time. In general, a slower speed and heavier cut and feed is more efficient.

As a sample of what may be done in general practice there is given a table of results, obtained at the Union Pacific shops, under new and old conditions in turning a pair of locomotive tires. These are average results and are not for a particular instance. They were reported in the Proceedings of the American Railway Master Mechanics' Association for 1904.

Comparative Time of Output of One Pair of Driving Wheels.

Operation.	Tool steel — Carbon. Hrs.	Min.	Air hardening. Hrs.	Min.	High speed Hrs.	Min.
Setting tool, etc., throughout job	1	30	1	00	0	36
Grinding rough tool	1	30	1	00	0	20
Grinding flanging tool	1	30	1	00	0	04
Roughing cut	8	00	5	00	1	00
Finishing cut	5	00	2	30	0	30
Flanging cut	2	30	1	30	0	30
Total labor	20	00	12	00	3	00

As a parallel to this, the average total time in the shops of the Pittsburg & Lake Erie Railroad Co. per pair of wheels, under old conditions, using air-hardening steel, was eight hours; under new conditions four pairs per day, or $2\frac{1}{2}$ hours per pair. This is not meant for a comparison of the two shops, as conditions may not be the same. But not the whole of this improvement is due to the tool steel. Much of it is due to better methods of driving and better facilities for handling the wheels. Many similar examples could be given. Later on in this paper reference will be made to some other results obtained in the P. & L. E. R. R. shops.

From the old hand driven or foot power tools to the line shaft belt driven shop was an immense stride, and as the machines themselves were improved so that some were all but human, it would seem that the limit had been reached. This was, of course, not true, even of the machine, and very much less so of the method of drive. The large belt-driven shops had become a perfect network of shafts, countershafts and miles of belting. These interfered greatly with the lighting and general cleanliness. Another great drawback was the lack of speed variation. The cone pulleys and back gearing, or its equivalent, could give as wide a total speed change as was desired, but the steps were too coarse. The average increase of speed by means of the cone pulley was 50 per cent. It may be assumed the average loss of speed would be 25 per cent., that is, one-half the speed increment. If now it were possible to decide, within 10 per cent., the speed a tool will stand, and if a method of control were put in to give that speed increment, then the loss of speed would average only 5 per cent. The advantage in favor of a close speed range would thus be 20 per cent., and if the average time the machines were running were 50 per cent. of the workman's time, then the net savings would be 10 per cent. If the mechanic's wages were \$3 a day, the saving would be 30c. a day, or \$100 a year per man.

(*To be continued.*)

The New Westinghouse "K" Triple Valve.

This valve, which was first publicly introduced at the West Seneca Tests on the Lake Shore & Michigan Southern Railway last October, is new more in designation than in detail, since it consists of an ordinary Westinghouse quick-action freight triple valve with a small addition and slight modification in the ports of the valve body and slide valve, designed to meet those conditions existing in the long-train service of the present day, which are not met with entire satisfaction by any present standard triple valve. Any Westinghouse freight triple valve can be made over into the "K" type with very little expense and during the usual time required for general repairs.

The principal advantages gained by such modification are:

(1.) Quick Action in Service Applications.—This is obtained by venting a certain amount of brake-pipe air to the brake cylinder at each triple valve during the service applications in a way similar to the emergency applications of the old triple valves, with less danger of undesired emergency applications, and with a greater degree of sensitiveness of graduation than can be obtained in the present standard valves.

(2.) Retarded Release of Brakes on the Forward Part of the Train.—This extremely desirable result is accomplished through an arrangement of ports in connection with a spring affecting the movement of the piston and slide valve in the release position in such a way that either a full or restricted exhaust port can be obtained as the position of the car in the train requires.

(3.) Even Recharge of Auxiliary Reservoirs Throughout the Train.—The "feed port" is so changed in relation to the triple-valve piston that its opening is reduced on such triple valves as are in the "restricted-exhaust" position, while those having the full exhaust opening also have the full recharging opening. This provides that all the brakes in the train may be recharged in about the same length of time. These very desirable results have long been sought after but never before obtained in a practicable shape. The quick-service feature insures a much more rapid response to service applications of the brakes on all lengths of trains. With the old triple valve on a 50-car freight train, it is necessary, in order to be sure that all brakes will apply, to make not less than a 7-lb. brake-pipe reduction. With the "K" triple valves under such conditions, a 5-lb. reduction will readily apply all brakes, thus materially reducing the loss of air from the brake pipe during an application. More than that, a reduction of pressure such as will insure the application of all the brakes on a 50-car train with the old style of triple valve develops only a small cylinder pressure on the rear cars of the train, while the new valve causes a pressure which is approximately equal on all the cars.

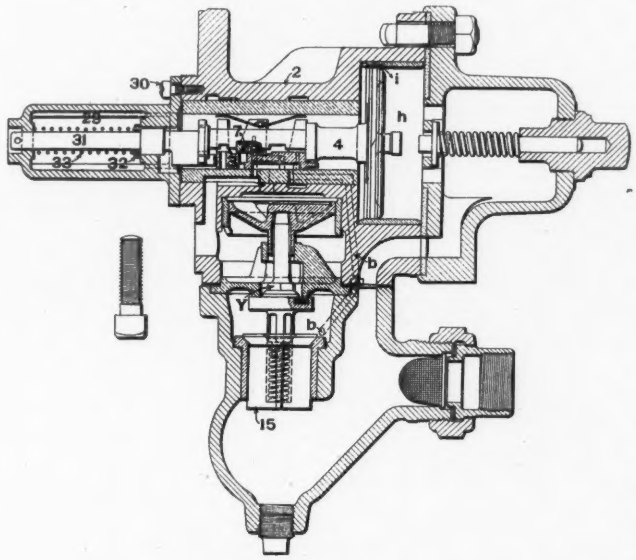
On a 100-car freight train it is impossible, with any present make of triple valve, to apply all the brakes with any service application. This applies even where the triple valves are all in first-class condition. With the "K" triple valve, however, no trouble is experienced in applying all of the brakes on this or even a greater length of train. With the ordinary triple valve on such a train, a 15-lb. brake-pipe reduction will apply from 76 to 81 brakes if Westinghouse triple valves are used; and from 50 to 61 if New York triple valves are used, referring to equipment with 8-in. x 12-in. brake cylinders in both cases. With the 10-in. x 12-in. brake-cylinder equipment, the number of brakes that will apply under similar conditions is considerably less than with the 8-in. With the "K" triple valve and its quick-service feature, however, a means of applying all the brakes is afforded with lighter brake-pipe reductions than are required with the old triple valve giving the unsatisfactory results above mentioned.

This retarded-release feature provides a means by which the brakes can be released at slow speeds without any danger of train partings. With the present equipment it is often necessary to bring

freight trains to a standstill before releasing the brakes if the speed has been reduced to ten miles an hour or less, and under certain conditions this speed limit is even greater. In many cases it is not practicable to release at slow speeds even when the engine has the independent straight-air brake to control the slack of the train. By proper manipulation of the brake-valve handle, this retarded-release feature puts into the hands of the engineer a means of (1) releasing the brakes at the rear end of the train first; (2) releasing those at the head end first, or (3) releasing the brakes throughout the train all at the same time.

The restricted recharging of the brakes on the forward cars causes the air pressure to rise more rapidly throughout the entire brake-pipe and makes more air available in a shorter time for releasing and recharging the rear brakes. This effectually obviates the tendency of the rear brakes to stick, because this tendency is due to the auxiliary reservoirs on the forward end absorbing so much of the air while recharging that the rear cars do not get the pressure required to promptly release their brakes. It also prevents re-application on the head end after release, due to the brake-pipe pressure there being lowered through the rear brakes still recharging after the forward ones are fully charged.

This feature also permits of the brake-valve handle being allowed to remain in the release position longer without overcharging the head of the train, thus more quickly building up the brake-pipe pressure, and, consequently, recharging the auxiliary reservoirs. Since those brakes at the rear of the train are charged in about the same time as those at the head end, a more evenly distributed braking power is obtained, causing each brake to do its



Westinghouse "K-1" Triple Valve.

share of the work, and avoiding the overheating of some of the wheels.

A 50-car freight train equipped with the new valve and running at a speed of 20 miles per hour will be brought to a standstill by a 5-lb. brake-pipe reduction in about 400 ft. shorter distance than with the old type, due to the more prompt application, higher average cylinder pressure and more positive action of the brakes. It requires a 20-lb. reduction with the old triple valves to stop in the same distance as the 5-lb. reduction just mentioned. More than this, the amount of free air saved on a 50-car train with 10-in. brake equipment, due to the lighter brake-pipe reductions and quick-service feature, is about 25 cu. ft. for every full application. And a full application with the new valve stops the train in 35 per cent. less distance than required with the standard valve.

The present standard Westinghouse freight triple valve may be transformed into the improved type by a simple change, preserving all the old parts except the body, slide-valve, slide-valve bush and graduating valve. This can be done when these valves are sent to the brake works for heavy repairs. Thus the cost of re-standardizing is reduced to a minimum, the time required will not exceed that allowed for ordinary repair work, and the railroads will get the advantage of using the parts of their own triple valves.

The accompanying illustration is a central vertical section through the "K" triple valve, from which the changes required to convert the old standard valve into this type will be readily understood. These changes are: A new body, *2*; a new slide valve, *3*; a new graduating valve, *7*, of the slide-valve type; the necessary modifications in the piston stem, *4*, required by the new type of graduating valve; the new slide-valve bush with proper re-arrangement of ports to suit the new slide valve, and the addition of the retarded-release feature, *29*, which in the ordinary freight equipment protrudes into the auxiliary reservoir volume. Besides this, the port *b* is drilled through the body and check-valve case in such a manner as to connect the chamber *Y* above the check valve to a port in the slide-valve seat. In the release position of the valve when used with the 10-in. brake equipment, this port *b* communicates through a port in the slide valve with the slide-valve chamber, and thus with the auxiliary reservoir, permitting air from the brake-pipe to raise the check valve *15* and pass through port *b* to the auxiliary reservoir. This is in addition to the supply that passes through the ordinary feed groove *i* around the piston, so that in full release position the auxiliary reservoirs will charge very rapidly. But if the valve is in the retarded-release position, port *b* connects with a much smaller port through the slide valve, while the piston fits closely against the ends of the slide-valve bush, cutting off any supply through feed groove *i*, thus greatly reducing the rate of recharge. This also applies to the valve when arranged for an 8-in. equipment except that communication between port *b* and the slide-valve chamber is broken during the full release, all the air for recharging then coming through the feed groove; while during the retarded release the port in the slide valve which opens *b* to the slide-valve chamber is about half the area of the feed groove. This difference exists because of the different volumes of air that have to be handled, while the feed grooves in both valves are the same size.

The retarded-release feature is made possible through the supplementary portion *29*, which consists of a brass frame casting open on both sides and attached to the triple-valve body by means of three screws, *30*; the stem, *31*, acts as a stop for the triple-valve piston when moving to the release position. Since it is held to its position by the spring *33*, and collar *32*, it will readily be seen that by properly proportioning this spring, the stem *31* can be made to compress the spring or not, depending on the rate of increase of the brake-pipe pressure in chamber *h*. If the triple valve is on the head end of the train, where the brake-pipe pressure builds up rapidly, spring *33* will be somewhat compressed by the piston when going to the release position, thus allowing the slide valve *3* to pass beyond full release position and partly close the exhaust port. As the brake-pipe pressure equalizes throughout the train, and feeds through into the auxiliary reservoirs, the difference of pressures on the two sides of the piston becomes less, and the slide valve is gradually forced back to the full exhaust opening.

Quick-Service Feature.—When the slide valve goes to the service-application position, its arrangement of ports is such that the chamber *Y* is connected through port *b* to the brake cylinders. These ports are so restricted that the resulting flow of air from the brake-pipe to the brake-cylinder through port *b* is not sufficient to cause an emergency application, but will materially hasten the brake-pipe reduction throughout the train. It is for this reason that a much smaller reduction is required at the brake valve to obtain a given brake-cylinder pressure than would be the case with the old type of triple valve. This is true not only because of less air exhausted to the atmosphere at the brake valve, but also because of the additional pressure derived from the air entering the brake cylinders from the brake pipe and thereby causing a higher brake-cylinder pressure.

In all other respects the operation of this valve is practically that of the present F 36 or H 49 triple valves. Its outward appearance, when attached to the auxiliary reservoir, is so much like those valves that, to distinguish it, a thin lug is cast on the top of the body in a position easily seen from the side of the valve; and its designation "K-1" or "K-2" is also cast on the side of the body, the former replacing the F 36 and the latter the H 49 standard valves.

A large number of these valves are already in service giving results that are in every way satisfactory. The serious problems brought forward by the rapidly changing conditions of freight service have made it absolutely necessary to increase the power and flexibility of the air-brake. Yet the adoption of any new device would entail such an immense amount of expense and inconvenience that the arrangement above outlined whereby the valves now in service can be utilized and transformed to give the required results with only a slight addition to the number of parts and with little expense, will prove to be one of the most important improvements yet brought out in connection with air-brake equipments.

Disastrous Collision at Adobe, Colo.

In a butting collision of passenger trains on the Denver & Rio Grande, about 2 o'clock on the morning of Friday, March 16, near Adobe, about 25 miles west of Pueblo, Colorado, twenty-two persons, nearly all passengers, were burned to death and 22 were injured. Westbound passenger train No. 3, drawn by two engines, moving up grade at moderate speed, collided with eastbound passenger train No. 16, piling up the three engines and the forward cars of the trains in a bad wreck, which took fire almost instantly.

The fire seems to have started from the coals in the fire boxes of the locomotives, but there was an explosion of illuminating gas which appears to have spread the flames. The collision occurred on a curve where an engineman has a view of an opposing train for only a few hundred feet; and, moreover, the track of the Atchison, Topeka & Santa Fe runs parallel to the Rio Grande track, making it easy to assume that an opposing train is on another track. There was a blinding snowstorm at the time, and the weather was so cold that the passengers suffered much from this cause. The reports indicate that the collision was due to a false report sent to the train despatcher by the operator at Swallows, a station east of Adobe. This operator had been asleep on duty, and when asked if train No. 3 had passed replied that it had not, whereas it had gone by while he was asleep. As a result of this misinformation, the despatcher issued an order to No. 16 based on his supposed ability to hold No. 3 at Swallows.

The following statement is published as from A. C. Ridgway, general manager of the company: "No 3, leaving Pueblo, had orders to meet No. 16 at Adobe. On account of delay in getting out of Pueblo after the train had left the order was changed to make the meeting point Beaver in place of Adobe. The despatcher had 'O. K.' from Florence and Swallows, the operator at Swallows stating that No. 3 had not gone by. He had been asleep beyond question; did not hear No. 3 go by and 'O. K.'d' despatcher's order, and is the sole cause of the collision. This was the day operator, and he was doing duty for the night man, as the night man had gone to Pueblo to cash pay checks without asking permission from the Pueblo office. Our standing rule is that day operators are not to relieve night operators and work overtime unless permission is asked and granted by the chief despatcher."

Railway Signal Association.

This association held its regular March meeting at the Great Northern Hotel, Chicago, March 19. Vice-President J. A. Peabody (C. & N. W.) presided. About 75 persons were in attendance at the two sessions, and 40 new members were elected. The revised constitution as published in the notice of the meeting was discussed, and a number of changes made. It was recommended that with these corrections it be presented at the New York meeting in May for adoption. The Committee on Standard Specifications for Mechanical Interlocking presented the following substitute for paragraph No. 74 of the specifications, which were referred back to the committee at the October meeting.

Specifications for Signal Poles.—All straight poles must be of lap-welded iron steam pipe in sections of 4 ft., 5 ft. and 6 ft., with swedged joints; the swedging to be 18 in. length and the male section inserted 16 in. The swedged ends must be hammer caulked. The total weight of 32-ft. poles, which must be set in concrete, shall be not less than 526 lbs.; for 38-ft. poles, 639 lbs. One-arm poles, set in base castings, must be 26 ft. long and weigh not less than 413 lbs. Two-arm poles must be 32 ft. long and weigh not less than 526 lbs. All these weights apply to poles without fittings.

Weights and lengths of pipe are fixed as follows: 4-in. section, 9 ft. 4 in. in length, to weigh 10.665 lbs. per foot; 5-in. section, 11 ft. 4 in. in length, to weigh 14.502 lbs. per foot; pipe of 6-in. section for poles set in the ground to weigh 18.762 lbs. per foot; for one-arm signals to be 14 ft. long; for two-arm, 20 ft. long; 6-in. section for one-arm poles set in base castings to be 8 ft. in length; 6-in. section for two-arm poles set in base castings to be 14 ft. long.

Concrete Foundations for Signal Poles.—Poles which are set in the ground must be reinforced by concrete not less than 12 in. by 12 in. by 6 ft. deep, and the pole filled with cement mortar 2 in. above concrete; and there must be a ¾-in. drain hole through the wall of the pipe at the top of the filling. Concrete foundations for base castings must be 30 in. by 30 in. at the top, and be not less than 5 ft. deep, with 1-in. slope per foot on the sides. Anchor bolts are to be 1 in. in diameter, and extended to within 12 in. of bottom of foundation.

These paragraphs were adopted and will be incorporated in the Standard Specifications printed in the 1905 proceedings as paragraph No. 124.

The paper by Mr. Spangler* on "Substituting Track Circuits for Detector Bars" evoked quite a lively discussion, and brought out the following points: The substitution of track circuits necessarily increases the number of insulated joints in and around switch points, which, from a track maintenance point, is undesirable. The relays used on the circuits release too slowly; to meet this condition about 60 ft. instead of the customary 45 ft. to 50 ft. should be allowed. Many of the speakers favored the retention of detector bars, and argued that they are giving full protection under all conditions, except with 100-lb. rails. Evidence was given to show that it costs a great deal less to maintain interlocking where track circuits are used, particularly during snow and sleet storms, when bars must often be disconnected. Mr. Sperry observed that the fundamental principle of the detector bar is wrong; a failure to come in contact with the wheel will cause an improper indication. This is not true of the track circuit, with which a failure will invariably give the desired protection by maintaining the route.

Mr. W. A. D. Short, Signal Engineer of the Illinois Central, presented a paper on power distant signals. He said that those roads in the Middle West which a few years ago thought the gas signal was the best for this purpose have found that the regulating mechanism of the gas signal is too delicate, especially where the signals cannot be inspected every day; and the electric motor is now being generally adopted. Mr. Short has secured information from 19 railroads representing 100,000 miles of road, and he finds that "five years ago the average distance of the distant signal from the home signal at interlocking plants was 1,444.44 ft., and from the interlocking machine it was 1,750 ft. To-day the average distance from the home signal to the distant is 3,745.64 ft., and of the distant signal from the interlocking machine 4,025 ft." Just what data were taken in computing these averages is not stated. Mr. Short says that where a power signal is used there should be an electric lock on the back latch of the home signal lever to absolutely ensure the distant signal being in the caution position before the home signal lever can be unlatched to be put in the normal position.

The discussion on this subject showed in a striking way what a change has come over signalmen's minds with reference to the use of the power distant signal. The recommendations of this Association in its favor, adopted two years ago, are now being followed by most of the important roads. There is a difference of opinion among members as to whether the power distant signal shall in all cases be controlled by a separate lever or shall be operated automatically. The latter method seems most likely to be generally adopted. With this, approach locking between the distant and home signals is easy and cheap. The matter of locking the home signal at "proceed" when the distant is at proceed, either mechanically or electrically, received some consideration, and the majority inclined to the opinion that some arrangement should be made whereby the home signal shall at all times be in such a condition that it can be set to the stop position quickly.

Switch signals came up for discussion under this head; and it developed that on many roads electric locking and time-interval locking is receiving considerable consideration. Members recognize the need of anticipating open switches, and the opening of switches in the face of trains.

*A report of Mr. Spangler's paper, and a notice of the revised constitution, as submitted by the committee, will be found elsewhere. A paper on Storage Battery Practice by Mr. F. B. Corey, is deferred to a future issue.

Temiskaming & Northern Ontario.

Ottawa, March 12, 1906.

This road, the new Ontario Government Railway into New Ontario, running north from North Bay to Liskeard, 113 miles, and passing through the Cobalt mining regions, was a distinct financial success last year, the first in which it was operated to its present terminus. The prospects for the coming year are that earning power will be greatly increased. The silver discoveries at Cobalt proved a silver mine indeed for this example of government ownership. Both passenger and freight traffic were largely increased, the latter both in ore coming out from the mines and machinery, building material, supplies and settlers' effects going in. Both kinds of traffic were hampered by lack of rolling stock. The passenger trains—one each way daily—afforded standing room only, and freight was often two or three weeks on the road from Toronto and Ottawa to Cobalt, which is 103 miles from the southern terminus of the Temiskaming road. In the coming season the equipment of the road will be even more severely tested. It is estimated that nearly 100,000 people will make for the new mining region this spring. The Provincial Commission, which manages the road, is taking steps to increase the equipment before next month, and to be ready to supplement it if necessary. A score of mines already shipping ore and a prospect that the number may be doubled, an influx of settlers into the clay belt which will soon become productive, the demands of business resulting from the opening of many stores in the new towns along the line—all these promise to add largely to the permanent earning power of the new road. Last year its net earnings were $113,000—$1,000 a mile. It is not unlikely that they will be three times that amount this year. There are 100 miles northward from Liskeard under construction and work is practically completed to within 35 miles of a junction with the projected line of the new National Transcontinental Railroad, the eastern end of the Grand Trunk Pacific. This is to be at a point about 142 miles north of Liskeard. With the construction of the new transcontinental, the Temiskaming & Northern Ontario would become both an important feeder and an outlet to the trunk line. In any case, as long as the prosperity of the mines continues, the road will be prosperous and to that extent will be a fine object lesson of the success of the principle of government ownership of railroads. J. A. M.

GENERAL NEWS SECTION

NOTES.

The Maine Central is to oil a considerable additional mileage of its roadbed the coming summer.

Re-examinations of sight are being made among the employees throughout the lines of the Pennsylvania Railroad.

A bill has been introduced in the legislature of Maryland to limit the working time of block signal operators to eight hours a day.

A press despatch says that the Chicago, St. Paul, Minneapolis & Omaha is to run its trains into the union station of the Union Pacific and turn its present passenger station into a freight house.

The People's Line steamers between New York and Albany began running on March 17. This is the earliest opening of navigation on the Hudson river for many years.

The government of Mexico is reported to have made arrangements for a subsidized line of steamers from Vera Cruz, Tampico, Progresso and other Mexican ports to various Canadian ports, including Montreal.

It is estimated that there will be 20,000,000 bushels of grain in store at the head of the Great Lakes at the opening of navigation, and more if the opening is late. There are now more than 18,000,000 bushels in store at Duluth.

According to a statement recently issued by the Mexican Government, 255 miles of railroad was built in that country in 1905, making a total mileage of 10,488 miles. The plans for new roads projected aggregate more than 1,000 miles.

A press despatch from Boston says that the New Haven road has sold the Park Square station. This station, the former passenger terminal of the Providence division, has been idle since the establishment of the South Station in 1899.

The Coal & Coke Railway, of West Virginia, has made an exclusive contract with the Hocking Valley by which its freight for the Northwest will be sent over the H. V. One account says that this traffic will amount to 10 train loads a day.

Western papers report that the railroads leading from the Missouri river to Colorado have reduced the through rate on cotton piece goods in accordance with the recent recommendation of the Interstate Commerce Commission. The reduction is from $1.25 to 80 cents.

The Alabama Railroad Commission has refused an application to reduce rates on cotton from the fields to Alabama mills, holding that the rates are already low; but the President of the commission, Mr. Comer, dissented, taking the ground that all freight rates are too high.

The Chicago, Milwaukee & St. Paul and the Chicago, Rock Island & Pacific are making arrangements to operate jointly their parallel lines between Neola, Iowa, and Council Bluffs, 20 miles, as a double-track road. Four stations are to be abandoned and joint stations operated at Neola, Underwood, Weston and Council Bluffs.

An officer of the New York Central is reported as saying that where two years ago 50 to 100 engines were required to keep the tracks of the company clear of snow, now no engines whatever are thus engaged. The present winter has been comparatively mild throughout the territory traversed by New York Central lines.

The Brotherhood of Railway Telegraphers having threatened recently to order a strike against the Southern Railway, that company, it is said, ordered a carload of telephones and had them distributed along the road, where they could quickly be put into service. Now the anticipated trouble has blown over and the telephones are to be returned.

The great exhibit of locomotives and models which was shown by the Baltimore & Ohio Railroad at the World's fairs in Chicago and St. Louis is now stored at Martinsburg, W. Va. The Field Columbian Museum, of Chicago, has an option on the collection, but its option expires with the present year, and Major Pangborn is looking about to see if some Eastern city does not want the collection. He says that a wealthy man is ready to give $100,000 as the beginning of a fund to bring the engines and models to Baltimore.

The annual report of the Omaha Grain Exchange shows an increase of nearly 100 per cent. in business. Total receipts of grain for 1905 were 34,523,500, against 16,433,285 in 1904. The 1905 receipts in details were: Wheat, 6,518,200 bushels; corn, 19,771,300; oats, rye and barley, 8,234,000. Two years ago there were three grain elevators in Omaha, with a combined capacity of 2,140,000 bushels, since then nine elevators with a combined capacity of 1,950,000 bushels have been constructed and three elevators, capacity 1,550,000, are under construction.

The Louisiana State Railroad Commission has imposed a fine of $500 on the Louisiana Western Railroad (a part of the Southern Pacific system) for failure to furnish cars when demanded by a shipper, in November last. The demurrage due to the shipper, according to the Commission's rules, was $68, and this the road refused to pay until the complaint was entered before the Commission. It is held, however, that in view of the persistent violation of the rule the payment of the $68 is not sufficient punishment, and therefore the fine of $500 is imposed.

A serviceable chemical fire extinguisher for use in passenger cars has not yet been found; at least such is the statement made by the lawyer of the Boston & Maine at a hearing before the legislative committee at Boston this week. The representative who introduced a bill to require the use of extinguishers says that he shall persist in his purpose, notwithstanding the recommendation of the state railroad commissioners that further investigation should be made before passing compulsory legislation. The Boston & Maine estimates that to supply all of its passenger cars with extinguishers would cost $25,000.

The Railroad Commission of Georgia has filed its annual report. Among the numerous recommendations offered to the legislature are the following: An act to compel railroads to put on extra passenger trains when the advertised schedule departure is delayed an unreasonable time; an act to compel railroads to place end platforms on freight cabs; an act empowering the commission to compel railroads to put in sufficient side tracks; an amendment to the present law requiring suit to recover penalties to be brought in the county in which the principal offices of the offending company are located, to the county in which the offense is committed; a mandatory law to compel offending roads to pay penalties without recourse to the courts to recover.

The volume of freight traffic on the railroads of South Carolina is this winter heavier than ever before, and the state railroad commissioners have in consequence received many complaints of delay—so many that they have issued a long explanatory statement. They say that the railroads did not expect such a great increase, and consequently are caught with many lines unfit for fast time in the winter season, and that, by reason of heavy rains, the roadbeds have in many cases been so damaged that even freight trains have to be run more slowly than usual. The commissioners say that all of the railroads made the serious mistake of not laying heavier rails and putting in more and better ballast last summer and fall. Shipments of fertilizer have increased one-third over former years.

A California paper reports that the directors of the California Fruit Growers' Exchange have passed resolutions asking Congress to expressly authorize the Interstate Commerce Commission to establish through rates and through routes. In other words, these fruit men do not admit the justice of the recent decision of the Supreme Court sustaining the railroads in their rule forbidding shippers to route their oranges. The resolution says that the railroads have not succeeded in making so good time as was made when the shippers routed the cars themselves; the time has been from two to six days longer, and there have been many losses by decay due to the delay. If these resolutions reflect the true condition it would seem that the evidence recorded by the courts was incorrect or incomplete; there appears to be something wrong.

The proposition before the legislature of Massachusetts to pass a law requiring the use of the block system in the state has taken a new shape; a bill drawn by the railroad commissioners having been substituted for that which was proposed by Representative Sullivan. The commissioners' bill will probably be reported to both the Senate and the House. It reads:

"Section 1. The Board of Railroad Commissioners may from time to time require railroad companies to install and maintain at such places upon the railroad premises as it shall designate such block or other signals or devices as it shall approve, for the purpose of safeguarding public travel.

"Sec. 2. The supreme judicial court shall have jurisdiction in equity to enforce compliance with any order issued by the board under the preceding section."

At the Interstate Commerce Commission hearing in Kansas City on rates charged by the railroads for carrying oil, testimony was offered to show that in Kansas the railroads carry oil for the Standard Oil Company at less than half the rates charged other shippers. E. L. Wilthoyt, formerly an agent at Topeka for the Standard Oil Company, but now an independent dealer, said: "The Standard Oil Company was charged $5 a car by the Terminal Company in St. Louis for transporting a car from East St. Louis, Ill., to St. Louis,

Mo. To save this $5 the Standard laid a pipe line under the river, and every car of oil bound westward would be pumped out in East St. Louis and pumped into another car in St. Louis." Mr. Wilthoyt said that while agent for the Standard at Topeka he got information from railroads as to competitors' shipments. "I was allowed $8 a month to spend with railroad employees in buying drinks and making myself a good fellow," he said, "and I was permitted to give away oil and gasolene to railroad employees and report such gifts as 'donations.' By keeping track of the shipments made by its competitors the Standard was enabled to know the name of every dealer who was buying oil from independents."

Derailment in Catesby Tunnel.

The latest accident report received from the British Board of Trade has to do with the derailment of a passenger train consisting of an engine and five eight-wheel cars, which was running through a tunnel at about 60 miles an hour—and no person suffered any bodily injury. Stranger still, only two passengers even made a claim of injury. The place of the accident was Catesby tunnel, on the Great Central, between Charwelton and Willoughby. The cause of the derailment is decided to have been a broken rail, which originally weighed 86 lbs. per yard, but which had been worn on its upper surface about ¼ in., reducing its weight to 76 lbs. per yard. There was a concealed flaw. The Inspector, Colonel von Donop, thinks that "the company should give careful consideration to the question" as to whether rails on the main line should not be renewed earlier. The Inspector condemns the use of gas for lighting cars. Three of those in this train were lighted by gas, and the lights in all of these were at once extinguished by the derailment, and there was a great escape of gas. It was only by taking the utmost precautionary measures that naked lights were kept away from the vicinity. The Inspector continued: "It is terrible to contemplate what might have been the results of this accident if an explosion had occurred or a carriage had caught fire in the tunnel." Further: "The leading and rear vehicles of the train were both lighted electrically; the lights in the latter were extinguished, but in the former vehicle they remained alight throughout, and were of the greatest assistance in rescuing and controlling the passengers," who numbered between 50 to 60.

Referred to Congressman Esch.

Perhaps the railroads are a unit in wishing that they could introduce the block system into the Federal and State legislatures.—*Baltimore American.*

A Municipal Ownership Incident.

The Staten Island ferry, running across New York Harbor from Manhattan to Staten Island, which is now owned by the city of New York, is to raise all fares to the uniform rate of five cents, except that to workingmen and school children season tickets will be sold, as now. The advance affects chiefly those passengers who travel on the railroad of the Staten Island Rapid Transit Company and who have ridden through from their residences to Manhattan on a single season ticket. The Commissioner of the Department of Docks and Ferries says that the advance is made because the boats do not pay expenses. The cost of running the line is much higher than formerly because the city gives shorter hours and higher wages, and also because it has put on new and larger boats, and larger forces of men. The Commissioner says that the deficit was expected; that the fault-finders should remember that the municipality does not run things as corporations do; that probably the city will finally carry the passengers free and charge the whole cost of the ferry to the tax payers.

New Signals on the Lackawanna.

The plans of the Delaware, Lackawanna & Western for the current year contemplate the installation of automatic block signals on the main line to complete the equipment of the line throughout its length from Hoboken to Buffalo, 410 miles. On the east side of Pocono mountain, where the down grade track is already signaled, Union electric motor signals, a home and a distant on each post, will be put in for 17 miles on the up grade track. On the other side of the mountain, 14 miles will be similarly equipped. This is from Nay Aug to Lehigh. The seven miles from Scranton to Clark's Summit will be signaled. From Mount Morris to Buffalo, 62 miles, a storage battery line will be installed similar to the lines farther east, such as were described in the *Railroad Gazette* of January 6, 1905. Between Mount Morris and Buffalo there will be 117 signals, all Union electric motor, the same as those in the other places mentioned, except that storage instead of primary batteries will be used. The electric generators will be 500 volt, 3¾ k.w., and the gasolene engines to run them will be of 6 h.p.; the generators and the engines both being considerably larger than those used on the lines built last year. The chloride accumulators will be of 24 ampere-hour capacity. There will be three power stations in the 62 miles.

The Lackawanna will also put in a number of new interlocking plants this year. Most of these will be mechanical, but with electric distant signals. At the Hoboken terminal, however, where the yard is to be greatly enlarged, there will be a new electro-pneumatic interlocking machine of 131 levers. The smaller electro-pneumatic machine now in use at the terminal will be re-erected at Grove street, a short distance west.

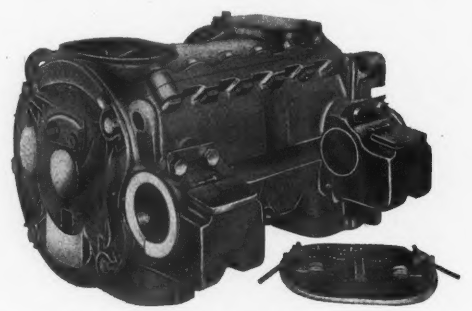
General Electric Single Phase Alternating Current Railway Motor.

Following is a brief description of the G. E. single-phase motor which has met with much success in traction service. For this class of work the General Electric Company furnishes a complete line of alternating current single-phase railway motors, including sizes of 75 h.p., 125 h.p. and 200 h.p. respectively. These various motors embody the same constructive principles as the GEA 605 (75 h.p.) type shown in the accompanying illustration. In general this motor is built with the same regard for constructive detail which characterize the GE direct current railway motor. The magnet frame is split and bolted together so that the armature may be readily accessible, and to further the ease of handling bails are cast into the frame. Provisions for ventilation and inspection of the interior of this motor are amply provided for and the opening over the commutator is closed with an iron cover with a felt gasket, and the cover is held in place by an adjustable cam locking device.

The frame heads are made of malleable iron cast in one piece. In order to secure large and long bearings without sacrificing other desirable features of construction, the heads are made conical in shape and extend under the commutator shell and pinion-end armature core head. The frame head castings have large oil wells into which oily wool waste is packed and comes in contact with a large surface of the armature shaft through an opening in the low-pressure side of the bearing linings.

The linings are unsplit bronze sleeves, finished all over with a thin layer of babbitt metal soldered to the interior bearing surface. Oil is prevented from entering the interior of the motor by oil deflectors which throw it into large grooves cast in the heads, from which it is carried away.

The armature coils are insulated with mica, enabling the armature to stand a high temperature without injury, and the armature



General Electric Company's Single-Phase Alternating-Current Railway Motor.

bars are soldered directly into the commutator car. The commutator is made up of segments of hard drawn copper, insulated throughout with mica. The cone micas are built up and pressed hard and compact in steam molds. The segment mica is made of a somewhat softer quality with the view of making it wear down evenly with the copper.

The brush-holders, four in number, are made of cast bronze and have two carbon brushes per holder. The brushes slide in finished ways and are pressed against the commutator by independent fingers which give a practically uniform pressure throughout the working range of the brushes.

There is a "pig tail" or shunt between the fingers and the brush-holder body to prevent current passing through the springs or pivoting pins.

The motor field consists of annular laminated punchings assembled into a cylinder and contains the exciting and compensating windings. The compensating winding consists of mica insulated bars inserted in partly closed slots in the face of the polar projections; all the bars being connected in series and the whole connected permanently in series with the armature at the motor and the two elements are treated as a single unit. The exciting winding consists of coils similar to the field coils of a direct current motor and may be removed as a unit, as is customary in direct current motors; that is, the spool surrounds a projecting pole piece.

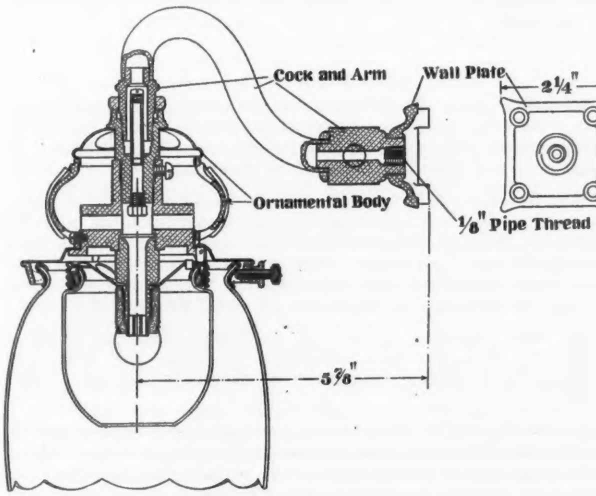
The 75 h.p. motor is wound for four poles and has four brush studs, while the 125 h.p. motor is wound for six poles and has six brush studs. The compensating winding is connected permanently in series with the armature, and the exciting windings are connected in series with these at the controller or commutating switch, where the change is made for reversing the direction of the motors and for changing the connections when desired to change from a.c. to d.c.

The armature speeds are relatively low, insuring good commu-

tation and absence of bearing troubles. For the control of these motors the General Electric Company has developed suitable hand controllers for single car operation and Sprague General Electric type M control for operation of cars in trains. The controlling apparatus is extremely simple, whether equipments are to be operated on alternating current alone or on both alternating and direct current circuits. As in most instances it will be necessary to operate alternating current equipments over existing direct current trolley lines, particular attention has been paid to simplifying the equipment for both a.c. and d.c. operation with the result that equipments of this type are practically automatic in changing over from one system to the other and can be handled by inexperienced motormen with success.

Inverted Mantle Pintsch Gas Lamps.

The new Pintsch inverted mantle lamp is now being generally applied to passenger cars of all classes throughout the United States. The high candle-power obtained and the advantages gained in the construction of the lamp permit of presenting this system of illumination under the most advantageous conditions. The use of opal, opalescent or art glassware makes it possible to bring together the rays from the separate burners so that the lamp presents a unit of light. The accompanying illustration of bracket-lamp No. 2515 shows the general arrangement of parts and the construction of the incandescent burners. The possibilities for artistic design when using the inverted mantle are shown in the interior view of a dining car equipped with Nos. 2512 and 2513 lamps. In using this new lamp there is obtained an illumination three times as great as that given by the present satisfactory flat flame Pintsch lamp, the merits of which have caused it to be applied to over 29,000 cars in the United States, Canada and Mexico, and on over 140,000 cars in the world. This additional light is secured without increasing the consumption of gas, and it is possible to remodel all the lighting equipment now in service with only a small expenditure for the new lamps. The inverted mantle with its holder are fitted into the globe, and this combination is handled as a unit, so that when the mantle has given its average service of three months the complete globe with its mantle, or, in other words, the bulb can be removed and a new bulb applied in just the same manner as an electric lamp is placed into its socket. The demand for improvement in artistic effects in lighting fixtures has been fully met by these new mantle lamps, which are made by the Safety Car Heating & Lighting Co., New York. A number of designs suitable for application to various classes of cars are illustrated in the company's new mantle lamp catalogue No. 441-A.



Section of Inverted Mantle Pintsch Gas Bracket Lamp.

Interior of Dining Car Lighted With Inverted Mantle Pintsch Gas Lamps.

Columbia Creosoting Plants for the Northern Pacific.

The Northern Pacific Railroad has contracted with the Columbia Creosoting Company for two timber preserving plants to be located at Brainerd, Minn., and Coeur d'Alene, Idaho, respectively. Each will be practically a duplicate of the Shirley, Ind., plant of the Columbia Creosoting Company, described in these columns last week. This company will prepare the plans and erect and install the plants, turning them over upon completion to the railroad company to operate, using the Lowry patents and processes. The plants will be so designed that either the creosoting or zinc chloride process can be administered. Work is to begin immediately, and it is expected to have both plants ready by October 1. The arrangement with the Northern Pacific contemplates an ultimate increase to five plants.

An Air Line (?) Across Pennsylvania.

The officer of the Pennsylvania Railroad who is disloyal to his company has never been heard of, or even imagined; yet we read in the *Harrisburg Patriot* that Third Vice-President Rea has come out in a letter advocating a rival line from Philadelphia to Pittsburg, and one 70 miles shorter than the Pennsylvania! The rivalry, however, is not likely to be at all acute, and Mr. Rea's proposition is not at all reprehensible. It is to rehabilitate and macadamize the old stage roads and make them fit for the use of automobiles, and he estimates that with efficient devil wagons the trip of 284 miles could be made between an early breakfast in Philadelphia and a dinner in Pittsburg, which means, we suppose, about 14 hours, or, say, 20 miles an hour. It appears that under a law passed in May, 1905, establishing a highway department, the state of Pennsylvania now stands ready to pay three-fourths of the expense of improving highways where citizens desire such improvement, and Mr. Rea thinks that the roads under consideration could be put in good shape for $2,500,000—one-fourth of which sum would be but a moderate burden on the counties. Many of the roads which make up this long route were originally built by corporations which charged tolls, and a few toll roads still remain. These would have to be bought up. From Philadelphia to Paoli, 20 miles, the toll road of the Lancaster Avenue Improvement Company, formerly the old Philadelphia and Lancaster turnpike, is excellent, but from Paoli to Lancaster much of the route is not well maintained. From Lancaster the line runs via Columbia to York, and thence to historic Gettysburg, where junction is made with the old turnpike from Baltimore (only 52 miles distant from Gettysburg), thence across South Mountain, well remembered as the line of retreat of Lee's army after the Battle of Gettysburg; thence into the beautiful Cumberland Valley at Chambersburg.

From Chambersburg westward, Sideling Hill, Tuscarora Mountain and other mountains are crossed. From Bedford the route crosses the main Allegheny range, the Somerset plateau, Laurel Hill Mountain, and into Ligonier Valley; thence through the gap in Chestnut Ridge, and by the Loyalhanna river, it rises through Greensburg, Irwin, Turtle Creek and into Pittsburg, 90 miles from Bedford.

Mr. Rea thinks that the old tavern stands and stage houses would soon be repaired and reopened, as has been the case in England, and he would look for a great influx of visitors. As Mr. Rea

has been in the engineering and real estate departments of the Pennsylvania Railroad for many years, his judgment in a matter of this kind is entitled to respect.

A Possible Competitor of the Philadelphia Rapid Transit.

The Philadelphia & Western, a company chartered in Pennsylvania to build a railroad from Parkesburg, Chester County, east to the western limit of Philadelphia (63d and Market streets), has applied for a franchise to build an elevated and underground road east across the city to the Delaware river, about five miles. Such a line would parallel the elevated and underground road now being built by the Philadelphia Rapid Transit Company. In its application for a franchise, the Philadelphia & Western makes a proposal to pay the city 2 per cent. of the gross earnings from passenger traffic within the city during the first two years of operation, 3 per cent. during the third year, 4 per cent. during the fourth year, and 5 per cent. during the fifth year and for 30 years thereafter. At the end of this time the property is to be turned over to the city, the company, however, having the option of leasing the road for a further period of 40 years at an annual rental of $400,000, plus the 5 per cent. of earnings as before. Work is under way on the Philadelphia & Western, but the company has been troubled with litigation. It was chartered, as was supposed, to build a road to be run by steam, but it is building with a view to using electricity.

It was announced in Philadelphia on Monday that Mayor Weaver had made an agreement with the Philadelphia Rapid Transit Company by which the company would release important franchises now held by it. To complete its subway and elevated lines it must have an extension of time, and, as a price of agreeing to this extension, the Mayor demanded and secured the surrender of the franchise for a subway under Chestnut street (which would leave an opening for the Philadelphia & Western) for surface lines on Broad street, and for elevated lines in a number of other streets and avenues. The company agrees to complete the Market street subway in three years, to build a subway north in Broad street, to build an elevated road throughout the thickly settled portion of the city, north and south, and to build a number of other lines. On Tuesday the directors of the Trades' League came out with a demand for much larger concessions, asserting that the Mayor had been far too easy. The directors of the Trades' League demand that the time extension desired by the Rapid Transit Company be refused unless it agrees to pay the city 5 per cent. on the gross earnings of the completed Market street elevated and subway line; to give up its right to build a subway in Broad street; to give up its right to build an elevated line to Frankford; to give up all other franchises upon which no work has been done; to give up about 21 miles of streets where tracks are laid but on which cars are not regularly operated.

Manufacturing and Business.

The H. W. Johns-Manville Company, through their Chicago branch, has just completed a large contract, for the installation of fire felt pipe and boiler covering in the new plant of Seers, Roebuck & Co., of Chicago, involving an expenditure of several thousand dollars. "Fire Felt" pipe covering, it is claimed, is absolutely fireproof, elastic, light in weight, and is unaffected by the expansion or contraction of the pipes.

The Rail Joint Company, New York, has closed contracts for the enlargement and new equipment of its works at Troy, N. Y. These improvements will enable the company to double its output of previous years. The works are now running day and night to keep pace with the growing demands from steam and electric railroads for the three types of base supported rail joints known to the trade as the Continuous, Weber and Wolhaupter types for tee and girder rail sections, also insulating and compromise or step joints to unite different sections of rails maintaining a perfect surface, and doing away entirely with low joints.

The Chicago Pneumatic Tool Company has closed its Norfolk office, which was located in the Chamberlain Building, and will, in the near future, open an office at Richmond, Va. Its office at 602 Empire Building, Pittsburg, Pa., will be closed April 1st, and moved to 10 and 12 Wood street, where a store building has been secured for the purpose of making a general display of air-compressors, tools, etc., a large stock of which will be carried as soon as the factories are in a position to furnish the same. An up-to-date repair department will also be maintained at that point for the benefit of customers in the Pittsburg district. The office at Seattle, Wash., has been closed and a new office opened at 84 Sixth street, N., Portland, Oregon. The company reports business entirely satisfactory both home and abroad, and all of its factories working double time.

OBITUARY NOTICES.

J. J. R. Croes, formerly President of the American Society of Civil Engineers, died on March 17 in Yonkers, N. Y., at the age of 71. Mr. Croes was engaged in the building of the Brooklyn water works from 1857 to 1860, and in the extension of the Croton water works after that. In 1863 he was First Assistant Engineer of the Washington aqueduct, and was later in charge for two years of the building of the storage reservoirs in the Croton water shed, north of New York City. He has been Engineer for several rapid transit commissions. In 1893 he was made Consulting Engineer to the New York State Health Department. He resigned from this position a year ago. He was Treasurer of the American Society of Civil Engineers from 1877 to 1887, and was its President in 1901.

Samuel O. Howe, Treasurer and Assistant Secretary of the Chicago & North-Western, died of heart failure in New York City on March 17. Mr. Howe had been on the C. & N.-W. for 35 years and had been Treasurer since 1898.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, see advertising page 24.)

New York Railroad Club.

At the April meeting of this club there will be a paper on "Superheaters," by H. H. Vaughn, of the Canadian Pacific.

American Society of Civil Engineers.

At the meeting of this society March 21, a paper on "New Facts About Eye-Bars," by Theodore Cooper, was presented for discussion. This paper was printed in "Proceedings" for January, 1906.

M. C. B. & M. M. Associations.

The Committee of Arrangements has decided to hold all business sessions of the Atlantic City conventions of the two associations in the sun parlor on the outer end of the steel pier, instead of in the hall over the entrance to the pier at the shore end. This will compel visitors to pass through the exhibits in going to and from the meetings. Under the original agreement with the Hotel Men's Association, the use of the east half of the pier was assigned for exhibition purposes on condition that the public be excluded. As this space was inadequate the entire pier has been secured, with the understanding that the public may be admitted. It is thought that this will not inconvenience the exhibitors and will secure a large amount of additional exhibit space.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Lehigh Valley.—J. A. Middleton, First Vice-President, has been put in charge of the operating department. The General Manager, Purchasing Agent and the Chief Engineer will report directly to him. T. N. Jarvis, Freight Traffic Manager, has been elected Second Vice-President in charge of traffic, Mr. Middleton having been, hitherto, at the head of this department. The offices of both will be in New York City.

Missouri Pacific.—J. D. Rockefeller, Jr., and E. P. Prentice have resigned from the Board of Directors. They are succeeded by J. H. Smith and S. D. Warfield.

Western Pacific.—George J. Gould, W. W. Miller, C. W. Slack, H. M. McCartney, J. F. Evans and Warren Olney, Jr., have been newly elected Directors. Those re-elected are: E. T. Jeffery, V. G. Bogue, W. J. Bartnett, Edwin Hawley, Warren Olney, W. J. Shotwell and J. D. Brown.

Operating Officers.

Atlantic Coast Line.—H. A. Ford, Superintendent at Gainesville, Fla., has been appointed General Superintendent of the Third division, with office at Jacksonville, Fla. The new office and its authority will cover all the lines in Florida.

Central of Georgia.—J. T. Johnson, General Superintendent of Transportation, has been appointed General Superintendent, and the office of General Superintendent of Transportation has been abolished. G. L. Candler, Superintendent at Savannah, Ga., has been appointed Superintendent of Transportation. J. C. O'Dell, Trainmaster at Savannah, succeeds Mr. Candler.

Chicago, Rock Island & Pacific.—C. J. Wilson, Superintendent at Fairbury, Neb., has been transferred to Estherville, Iowa, succeeding C. L. Brown, who takes Mr. Wilson's position at Fairbury.

Mexican Pacific.—A. P. Herbert has been appointed Superintendent of the completed line from Colima, Mex., to Manzanillo, 60 miles, this being part of the property of the Mexican National Construction Co., recently acquired by the Mexican Pacific.

Engineering and Rolling Stock Officers.

Louisville & Nashville.—E. L. Cruger, Assistant Engineer at Knoxville, Tenn., has resigned to become Chief Clerk to the Chief Engineer of the Chicago & Alton.

Mexican Central.—C. H. Burk, Master Mechanic at Chihuahua, has been appointed Assistant Superintendent of Machinery, with office at Aguascalientes. R. H. Rutherford, Assistant Master Mechanic of the Mexico division, succeeds Mr. Burk, and his previous position is abolished. J. J. Cavanugh is appointed Master Mechanic at San Luis Potosi, succeeding T. Smith, resigned.

LOCOMOTIVE BUILDING.

The Central of Georgia, it is reported, is in the market for upwards of 30 locomotives.

The Tidewater, it is reported, has ordered six locomotives from the Baldwin Locomotive Works.

The Pittsburg & Lake Erie will build ten 6-wheel switching locomotives in its shops at McKee's Rocks.

The Louisville & Nashville has ordered 30 consolidation freight locomotives, with cylinders 21 in. x 28 in., from the Baldwin Locomotive Works.

The Tramway Rural, Buenos Ayres, has ordered two standard gage passenger locomotives, with cylinders 12 in. x 15 in., from the H. K. Porter Co.

The Ruddock-Orleans Cypress Co., New Orleans, La., has ordered one Mogul locomotive, with cylinders 14 in. x 20 in., from the H. K. Porter Co.

The Minnesota Land & Construction Co., Duluth, Minn., has ordered one Mogul locomotive, with cylinders 16 in. x 24 in., from the H. K. Porter Co.

Messrs. Vaccaro Bros. & Co., Salado, Spanish Honduras, have ordered a 36-in. gage passenger locomotive, with cylinders 10 in. x 16 in., from the H. K. Porter Co.

The Lake Erie & Western, it is reported, will soon be in the market for additional locomotive equipment, including passenger, freight and switching locomotives.

The Boyne City Chemical Co., Boyne City, Mich., has ordered a six-wheel (0-6-0) switching locomotive, with cylinders 12 in. x 16 in., from the H. K. Porter Co.

The Boston Consolidated Mining Co., Salt Lake City, Utah, has ordered five 36-in. gage contractors' locomotives, with cylinders 10 in. x 16 in., from the H. K. Porter Co.

The Central San Cristobal, Porto Rico, has ordered one eight-wheel saddle tank locomotive of one meter gage, with cylinders 10 in. x 14 in., from the H. K. Porter Co.

The Lima Locomotive & Machine Co. reports the following orders during the past week for its Shay locomotives: Owl Bayou Cypress Co., Louisiana, one 15-ton locomotive; Kirby Lumber Co., Texas, two 37-ton locomotives; Beaumont & Northern R. R., Texas, one 28-ton locomotive; Lackawanna Lumber Co., Pennsylvania, one 65-ton locomotive; Standard Lumber Co., Louisiana, one 20-ton locomotive; Port Susan Logging Co., Oregon, one 37-ton locomotive; Oregon Timber Co., Oregon, one 37-ton locomotive, and the Kilpatrick Bros. & Collins, Nebraska, one 45-ton locomotive.

The Minneapolis & Rainy River, as reported in our issue of March 16, has ordered three simple (2-6-0) locomotives from the American Locomotive Co., for April delivery. These locomotives will weigh 124,000 lbs., with 108,000 lbs. on the drivers; cylinders, 19 in. x 24 in.; diameter of drivers, 54 in.; extended wagon top boiler, with a working steam pressure of 180 lbs.; heating surface, 1,560.61 sq. ft.; 236 tubes, 2 in. in diameter and 11 ft. 8 in. long; firebox, 96 in. x 41¼ in.; grate area, 28.12 sq. ft.; tank capacity, 4,000 gallons, and coal capacity, seven tons. The special equipment includes: Westinghouse air-brakes, National-Hollow brake-beams, Tower couplers, Nathan triple injector and Midvale driving wheel tires.

The Atlantic Coast Line has ordered 27 10-wheel simple freight locomotives and 20 six-wheel simple switching locomotives from the Baldwin Locomotive Works. The freight locomotives will weigh 155,000 lbs., with 115,000 lbs. on drivers; cylinders, 20 in. x 26 in.; diameter of drivers, 63 in.; straight top boiler with a working steam pressure of 200 lbs.; total heating surface, 2,675 sq. ft.; 336 Shelby tubes, 2 in. in diameter by 14 ft. 5 in. long; firebox, 96¼ in. x 66 in.; grate area, 44.1 sq. ft.; tank capacity, 6,000 gallons, and coal capacity, 11 tons. The special equipment will include: Westinghouse air-brakes, Hammond steel axles, Keasbey & Mattison sectional boiler lagging, Diamond special brake-beams, Perfecto brake-shoes, Dressel headlights, Hancock injectors, Damascus bronze journal bearings, U. S. piston rod and valve stem packings, Star safety valves, Leach's sanding devices, new Nathan bull's-eye sight-feed lubricators, Atlantic Coast Line standard springs, Crosby steam gages, Standard steel driving wheels; cast-steel wheel centers, Linstrom eccentric blocks and Richardson balanced slide valves. The switching locomotives will weigh 110,000 lbs.; cylinders, 19 in. x 24 in.; diameter of drivers, 50 in.; straight top boiler, with a working steam pressure of 180 lbs.; total heating surface, 1,669 sq. ft.; 213 tubes, 2 in. in diameter by 14 ft. long; firebox, 71$^{11}/_{16}$ in. x 34⅜ in.; grate area, 17$^{8}/_{10}$ sq. ft.; tank capacity, 2,500 gallons, and coal capacity, seven tons. The special equipment will include: Westinghouse friction draft gear on pilot and tender, Westinghouse air-brakes, Tower couplers and Monitor injectors. The other equipment will be similar to that given for the 10-wheel locomotives.

The Atlanta & West Point, as reported in our issue of March 9, has ordered two simple 10-wheel (4-6-0) passenger locomotives, two simple 10-wheel (4-6-0) freight locomotives and one switching locomotive from the Rogers Locomotive Works, for April delivery. The passenger locomotives will weigh 191,000 lbs., with 153,000 lbs. on the drivers; cylinders, 21 in. x 28 in.; diameter of drivers, 78 in. (outside); wagon top boiler, with a working steam pressure of 200 lbs.; heating surface, 3,100 sq. ft.; 335 Detroit seamless tubes, 2 in. in diameter and 15 ft. long; carbon firebox, 133 in. x 41 in.; grate area, 38 sq. ft.; tank capacity, 7,000 gallons, and coal capacity, 12 tons. The freight locomotives will weigh 180,000 lbs., with 142,000 lbs. on the drivers; cylinders, 21 in. x 28 in.; diameter of drivers, 60 in.; wagon top boiler, with a working steam pressure of 200 lbs.; heating surface, 2,393.76 sq. ft.; 335 Detroit seamless tubes, 2 in. in diameter and 13 ft. 8 in. long; carbon firebox, 123 in. x 40 in.; grate area, 34.6 sq. ft.; tank capacity, 7,000 gallons, and coal capacity, 12 tons. The switching locomotive will weigh 117,000 lbs.; cylinders, 19 in. x 24 in.; diameter of drivers, 50 in.; straight boiler, with a working steam pressure of 180 lbs.; heating surface, 138.3 sq. ft.; 225 Detroit seamless steel tubes, 2 in. in diameter and 11 ft. 2 in. long; flange firebox, 96 in. x 33 in.; grate area, 22.26 sq. ft.; tank capacity, 3,500 gallons, and coal capacity, five tons. The special equipment for all includes: Westinghouse air-brakes, Cook's bell ringer, Philiy Carey Manufacturing Co.'s boiler lagging, National-Hollow brake-beams, Lappin brake-shoes, Tower steel couplers, Pyle-National electric headlights for passenger and freight locomotives, Monitor injector, Ajax journal bearings, Jerome piston and valve rod packings, Ashton safety valves, Watters sanding devices, Nathan bull's-eye sight-feed lubricators, Railway Steel Spring Co.'s springs, Ashton steam gages, Gold steam heat equipment for passenger and freight locomotives, Midvale driving, truck and tender wheel tires for passenger and freight locomotives, and Midvale driving wheel tires for switching locomotive. Other specialties for passenger and freight locomotives are Elvin automatic driving box lubricators.

CAR BUILDING.

The Chicago & Illinois Western is in the market for freight equipment.

The Lake Erie & Western is in the market for 17 coaches and four smoking cars.

The Chicago Union Traction, it is reported, will shortly be in the market for new cars.

The Contract Process Co., Buffalo, N. Y., has purchased three tank cars from Robt. M. Burns & Co., Chicago.

The Poudre Valley Gas Co., Fort Collins, Col., has purchased two tank cars from Robt. M. Burns & Co., Chicago.

The Pittsburg & Butler Street Railway has ordered 10 interurban cars from the Niles Car & Manufacturing Co.

The Louisiana Railway & Navigation Co. has ordered 250 coal and 250 box cars from the American Car & Foundry Co.

The Lake Shore & Michigan Southern expects to have its gasolene motor car completed by the latter part of March. The car is being built in the company's own shop.

The Erie has ordered 25 passenger cars from the American Car & Foundry Co., and is reported as in the market for 500 steel underframe twin-hopper gondola cars of 100,000 lbs. capacity.

The White Oak Railway is in the market for 1,000 all steel and 1,000 combination wood body and steel hopper bottom cars of 100,000 lbs. capacity. Mr. R. W. Kirtley, Macdonald, W. Va., is Purchasing Agent, and Mr. S. Dixon, Macdonald, W. Va., is General Manager.

The Alabama Great Southern is in the market for 1,000 box cars of 60,000 lbs. capacity, 250 self clearing steel hopper cars of 100,000 lbs. capacity, 250 coke cars of 60,000 lbs. capacity, 250 40-ft. flat cars of 80,000 lbs. capacity, and 250 40-ft. self-clearing gondola cars of 80,000 lbs. capacity.

The Cincinnati, New Orleans & Texas Pacific is in the market for 1,250 wooden drop bottom coal cars of 60,000 lbs. capacity, 1,000 box cars of 60,000 lbs. capacity, 250 40-ft. flat cars of 80,000 lbs. capacity, 250 40-ft. drop bottom gondola cars of 80,000 lbs. capacity, and 250 coke cars of 60,000 lbs. capacity.

The Illinois Central has ordered 400 Hart convertible cars of

80,000 lbs. capacity from the Rodger Ballast Car Co. The cars are to be built by the American Car & Foundry Co., and are for June or July delivery. They will measure 36 ft. 10 in. long by 10 ft. 2⅜ in. wide by 8 ft. 3¼ in. high over all.

The Madison & Interurban Traction Co., Madison, Wis., has ordered 11 Brill semi-convertible cars from the American Car Co., for May delivery. These cars will measure 31 ft. long by 8 ft. 4 in. wide over all. The special equipment will include Peacock air-brakes, Brill couplers and trucks, Acme curtain fixtures and Griffin steel tired wheels.

The Midland Valley, as reported in our issue of February 16, has ordered 300 gondola cars of 80,000 lbs. capacity from F. M. Hicks & Co. These cars will weigh 33,000 lbs., and measure 35 ft. 7½ in. long, 9 ft. 4 in. wide and 4 ft. 1 in. high, all inside measurements. The special equipment includes: Simplex bolsters and brake-beams, Christie brake-shoes, Westinghouse air-brakes, More-Jones brasses, Tower and Climax couplers, Miner draft rigging, McCord journal boxes, Sherwin-Williams paint and Mt. Vernon wheels.

The Erie has ordered a 100-h.p. Ganz steam automobile car for July or August delivery as an initial step toward the adoption of such cars for its branch line passenger traffic. The car will be of all steel construction. It will measure 57 ft. long over all, and will weigh 40 tons in working order, and is designed to maintain a speed of 48 miles per hour on a level track. This car will have a seating capacity for 60 passengers and will be fitted with a Ganz water tube steam generator having a working pressure of 300 lbs. It will carry about 700 gallons of water and from 800 to 1,000 lbs. of coke.

The Atlanta & West Point has ordered 180 cars from the Louisville & Nashville to be built at its Decatur shops. The order calls for 55 box cars of 65,000 lbs. capacity, fifty 40-ton drop bottom coal cars of 80,000 lbs. capacity; 50 flat cars of 80,000 lbs. capacity and 25 furniture cars of 65,000 lbs. capacity. The box cars will measure 36 ft. long by 9 ft. wide by 9 ft. 2 in. high, all inside measurements. The bodies and underframes will be of wood. The flat cars will measure 40 ft. long by 9 ft. wide, inside measurements, and will also be of wood. The furniture cars will measure 45 ft. long by 9 ft. wide by 10 ft. 2 in. high. The special equipment for all will include the American Steel Foundries cast steel body and truck bolsters, Simplex brake-beams, Westinghouse air-brakes, Ajax plastic bronze brasses, Tower couplers, Security door fasteners for box cars and furniture cars, Miner tandem draft rigging, McCord dust guards and journal boxes, St. Louis Roof Company's roofs, Railway Steel Spring Co.'s springs and arch bar trucks.

The Atlantic Coast Line has ordered 2,000 steel underframe box cars of 60,000 lbs. capacity from the South Baltimore Steel Car & Foundry Co., for May delivery; 500 flat cars of 60,000 lbs. capacity from the South Atlantic Car & Manufacturing Co., and 40 passenger coaches from Harlan & Hollingsworth, for July delivery. The box cars will weigh 36,500 lbs. and measure 36 ft. long, 8 ft. 6 in. wide and 7 ft. 5⅛ in. high, inside measurements. The flat cars will be 40 ft. long, over end sills; 9 ft. wide, over side sills, and 4 ft. 4¼ in. high, over floor. The special equipment for box and flat cars will include: Pennsylvania brake-beams, Christie brake-shoes, Westinghouse air-brakes, Tower couplers, National Malleable Castings Co.'s door fastenings and Farlow-Westinghouse friction draft rigging for box cars; Thornburg tandem draft rigging for flat cars, Harrison dust guards, Symington journal boxes for box cars and National Malleable Castings Co.'s journal boxes for flat cars, Atlantic Coast Line standard paint, Atlantic Coast Line double board roofs for box cars, Atlantic Coast Line standard springs and Atlantic Coast Line standard arch-bar trucks. The passenger coaches will weigh 81,000 lbs. and measure 61 ft. 3 in. long, over end sills, and 9 ft. 8 in. wide, over side sills. The special equipment will include: Diamond special brake-beams, Christie steel back brake-shoes, Westinghouse automatic air-brakes, Janney-Buhoup couplers, Forsyth or National curtain fixtures, Pantasote curtain material, Adams & Westlake door fastenings, Westinghouse friction draft rigging, Harrison dust guards, Gold heating system, National Malleable Castings Co.'s journal boxes, Pintsch light, Pullman standard outside paint, Atlantic Coast Line standard springs, Pullman wide vestibules and Atlantic Coast Line special 36-in. chilled cast wheels. Other specialties are: Adams & Westlake polished bronze trimmings and Linström hand brakes.

BRIDGE BUILDING.

ALABAMA.—On March 13 the United States Senate passed a bill authorizing the Mobile Railway & Dock Co. to build bridges across Dog river and Fowl river, in Mobile County, Alabama.

CALHOUN, GA.—Bids are wanted April 4 by the County Commissioners for building a steel bridge 220 ft. long over the Oostanaula river in Gordon County.

CRAMPTON, MD.—The Commissioners of Queen Anne County will shortly ask for bids for putting up a steel bridge 75 ft. long. A. B. W. Mitchell is Clerk, of Centerville.

FOREST CITY, IA.—Bids are wanted April 3 by Leo Aspalin, County Auditor, at Garner, Ia., for building a steel bridge over Lime creek, 100 ft. long, in Hancock County.

LLOYDMINSTER, ALB.—The government has decided to build a bridge over the Battle river at this place. R. W. McIntyre, of Edmonton, Alb., may be addressed.

LOUISVILLE, KY.—The Louisville, Henderson & St. Louis is having plans made to substitute steel structures for many of the wooden bridges on its line.

MADISON, ARK.—The Madison Bridge Co., of Forest City, is asking for incorporation, with a capital of $40,000, to build a bridge over the St. Francis river at this place. The directors include S. H. Mann, T. C. Marwin and E. A. Rolfe. The Lower House of Congress has passed a bill authorizing this work.

MINNESOTA.—The Duluth, Rainy Lake & Winnipeg and the state of Minnesota, it is reported, are planning to jointly build a bridge over the river at Fort Francis. The railroad has bought the land necessary for the Canadian approach.

OROVILLE, CAL.—Bids were recently asked by the County Supervisors for a highway bridge to be built over Butte creek, four miles west of Nelson in Butte County, to consist of one 60 ft. steel span, with 540 ft. of pile trestle work.

The Board of Supervisors of Butte County has agreed to pay half of the cost of a steel drawbridge over the Sacramento river, between Butte and Glenn Counties, if the latter county will pay the other half.

PHILADELPHIA, PA.—The Board of Supervisors have approved the plans for the Walnut Lane bridge to be built over the Wissahickon to connect Germantown and Chestnut Hill with Manayunk and Roxborough. The proposed structure will be built entirely of concrete, and with a total length of 565 ft. and 60 ft. wide. The central span over the creek will be 233 ft. long. The cost of the structure will be $250,000.

ST. ANNE'S, QUE.—The Canadian Pacific, it is said, has decided to rebuild the bridge over the Ottawa river at this place.

ST. PAUL, MINN.—Both Houses of Congress have approved the building of a bridge over the Mississippi river between the Fort Snelling Military Reservation and St. Paul.

SAN FRANCISCO, CAL.—The California Northwestern will build a double-deck bridge 160 ft. long over Hulbert's creek near the entrance to Guernwood Park. The upper deck will be used for highway traffic.

SUNNYSIDE, N. MEX.—The Atchison, Topeka & Santa Fe will build a bridge over the Rio Pecos on the line of its cut off from Belen to Texico. The work on the bridge will be difficult because of quicksand and will take about eight months to complete the structure.

TENNESSEE.—Both Houses of Congress have passed bills authorizing the Cairo & Tennessee River Railroad to build bridges over the Tennessee and Cumberland rivers in Tennessee.

TOLEDO, OHIO.—Resolutions have been introduced in the City Council providing for a viaduct 93 ft. long, also for the removal of the present Cherry street bridge to Ash and Consaul streets. A number of resolutions have been previously filed seeking the removal of this structure.

VAN BUREN, MAINE.—A bill was introduced in the House of Representatives on March 12 making an appropriation to aid in building a bridge across the St. John river between this place and St. Leonard's, New Brunswick.

WATERS FERRY, ALA.—On March 13 the United States Senate passed the bill authorizing the Commissioners' Court of Baldwin County, Ala., to build a bridge over the Perdido river at this place.

WILLIAMSON, W. VA.—On March 12 the United States Senate passed the bill authorizing William Smith and associates to bridge the Tug Fork of the Big Sandy river near this place. (March 2, p. 70.)

Other Structures.

ALLENTOWN, PA.—The Central Railroad of New Jersey has bought land as a site on which it will put up a large roundhouse and a shop. Work is to be started at once.

DECATUR, ILL.—Revised plans have been completed for the Wabash shops. They call for 15 buildings, the two largest of which will be the car shop and the machine shop. Work is to be started early next month, and completed during the present year.

FARGO, N. DAK.—The Great Northern is having plans made for putting up a new passenger station here, for which bids are to

be asked shortly. Plans are also being made for a new freight house, to be 40 ft. by 600 ft.

INDIANAPOLIS, IND.—The Big Four, it is said, has bought 2,640 acres of land on the south adjoining Indianapolis, as a site for shops. An appropriation of $3,500,000 has been made by the company to build a town at this place to be called Beech Grove.

LONSDALE, TENN.—The Southern, it is said, will enlarge its shops at this place to double their present capacity, at an expense of about $1,000,000.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Co. has secured land on Third street as the site for a large terminal building to cost about $300,000.

MONCTON, N. B.—The shops of the Intercolonial, recently destroyed by fire, it is announced, will be replaced as soon as possible with new structures.

OAKLAND, CAL.—The Southern Pacific has applied for permission to build its new machine shop, boiler shop, copper shop and roundhouse at Oakland, near the Perlata street front slip. Piling foundations for the machine shop, 195 ft. by 500 ft., have been completed and work on the superstructure will soon be commenced.

PHILADELPHIA, PA.—The Baltimore & Ohio is planning to spend $750,000 for terminal facilities at Philadelphia. The work includes the building of a roundhouse, a car and locomotive repair shop and other structures, also a freight yard. Land has been bought between Twenty-fifth and Dickinson streets and Thirty-sixth street and the Schuylkill river. The company intends to begin work as soon as its plans are approved by the city officials. The object of this work is to improve its freight handling facilities, and as soon as the new buildings are completed the present shops will be abandoned.

PROCTOR, B. C.—The Canadian Pacific, it is reported, will put up a new station here.

SEATTLE, WASH.—The Union Pacific is planning to build solid concrete quays at a cost of about $1,000,000 on Salmon Bay. The bay will be connected with Puget Sound by a channel now being widened and dredged by the government. The Great Northern and the Northern Pacific also own large tracts of land suitable for terminal purposes within a few miles of the entrance of Salmon Bay.

SPOKANE, WASH.—The Oregon Railroad & Navigation Co. has bought land on North Monroe street as a site on which it will put up large warehouses.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

CANADIAN PACIFIC.—This company has announced that it will extend its Yorkton branch to Wetaskiwin 50 miles south of Edmonton. About 300 miles of this branch has already been built, and when completed it will form a trunk line 800 miles long from Winnipeg to Edmonton, 200 miles shorter than the present railroad distance between these two towns. The work includes the building of a high level bridge over the Saskatchewan between Strathcona and Edmonton.

CHESTER, PERRYVILLE & STE. GENEVIEVE.—This company has extended its road from Perryville, Mo., southeast to Cape Girardeau, 47 miles.

CHICAGO & NORTH-WESTERN.—The Ashland division of this road, which formerly ended at Laona, Wis., has been extended to Long Lake, 20.5 miles.

CHICAGO, BURLINGTON & QUINCY.—This company, according to the newspapers, has had incorporated in Colorado the Denver, Utah & Pacific, to build a line from Denver to the Pacific Coast, and from Denver to a connection with the Burlington lines in Wyoming. There was a company of this name several years ago, but its charter has lapsed.

CHICAGO GREAT WESTERN.—Work has been started by A. D. Eizle, who has the contract, for double-tracking this road at Helena Junction. The road is to be made double track between Dubuque and Chicago.

CHICAGO, MILWAUKEE & ST. PAUL.—An officer is quoted as saying that the work to be carried out by this company during the present year includes the rebuilding of 400 miles of its road from St. Paul to the Missouri river, which will form part of its Pacific Coast line, and the double-tracking the Chicago-St. Paul line. This line is 420 miles long; 228 of this is double track, and 77 miles additional will be completed this year. It is intended to have the remaining 115 miles completed by the time the trans-continental line is finished. Between Chicago and Omaha, 500 miles, about 208 miles is double track and $500,000 will be spent reducing the grades.

CINCINNATI, NEW ORLEANS & TEXAS PACIFIC.—A charter has been granted in Kentucky to this company to build a branch 25 miles long, from Sloan's Valley, in Pulaski County, to the confluence of the Laurel and Cumberland rivers.

See Kentucky & Southeastern.

DULUTH, RAINY LAKE & WINNIPEG.—A contract has been given by this company to P. McDonnell, of Duluth, for building 65 miles of its proposed extension from Ashawa, Minn., north to Pether's point on Rainy river, about two miles from International Falls. The contract includes grading, ballasting, track laying and bridge construction, and calls for the completion of the work by June 1, 1907. The line will be continued to International Falls, where a bridge will be built over the river by the Rainy River Bridge Co., recently incorporated for this purpose, and will ultimately be extended further north. The road will connect with the Canadian Northern, giving a through connection with Winnipeg and the Canadian Northwest.

GRAND TRUNK PACIFIC.—Bids were recently received for building 245 miles of this road east from Winnipeg, also 155 miles west from Quebec, and a steel viaduct 3,000 ft. long at Cape Rouge Valley. The bidders for building the road were the Pacific Construction Co.; M. J. O'Brien; J. P. Mullarky; Hogan & MacDonald; McCarthy Construction Company, Ltd., of Canada; H. M. Davis and J. T. Davis; Connolly, Wilson & Jardine, and J. D. MacArthur; and for the bridge the Dominion Bridge Co.; Locomotive & Machine Co., of Montreal; Phœnix Bridge Co., of Pittsburg, and the Canadian Bridge Co., of Walkerton, Ont. Contracts for the work will soon be let. The Canadian Government's estimates for the next fiscal year provide for an expenditure of $10,000,000 on this eastern section of the Grand Trunk Pacific, which is being built by the government.

GREAT NORTHERN.—According to newspaper reports large tracts of land are being bought for J. J. Hill in Saskatchewan, with a view of building various branch lines from the boundary. It is said that the company will build into Regina during the present year, and that plans are being made for making a through line from Lethbridge to Winnipeg, passing a few miles south of Wayburn, with branches into wheat-growing territory.

GREAT WESTERN.—This company has now in operation a branch from Johnstown, Colo., to Liberty, 11.9 miles.

HANOVER RAILWAY.—Incorporation has been granted this company in Illinois, with a capital of $650,000, to build a line from the Chicago, Burlington & Quincy, at Hanover station in Joe Daviess County, to the Chicago Great Western at North Hanover in the same county. The office of the company will be at Hanover. Incorporators include: William Speer, John Eadie and Albert B. White, all of Hanover.

INLAND EMPIRE.—J. P. Graves and associates have organized a company in the state of Washington, under the above name, with a capital of $20,000,000, to consolidate a number of existing electric roads and to build extensions. The companies to be included are: Cœur D'Alene & Spokane, operating 34 miles between Spokane and Cœur D'Alene, Idaho; the Spokane Traction Co., operating a system in the city of Spokane; the Spokane & Inland, which is building south from Spokane to Palouse and Colfax (partially completed), and the Spokane Terminal Company, which is putting up a terminal station in Spokane for these three other companies. Money has been secured by the new corporation to carry out the work, to include the extension of the Spokane & Inland to Snake river. There it will connect (at Lewiston) with the Lewiston & Southeastern system, which has already let contracts for building its line from that place to Grangeville, Idaho. Other work includes the extension of the line west from Spokane into the Big Bend country.

KENTUCKY & SOUTHEASTERN (C., N. O. & T. P.).—A charter has been granted this company to build a line southeast through Breathitt, Perry, Knott and Letcher Counties, Ky., a distance of about 70 miles.

LORAIN SOUTHERN.—Announcement has been made by Joseph Ramsey, former President of the Wabash, that he has organized a company under this name, and also bought the Industrial Railroad of Lorain from the Sheffield Land Company. He proposes to build a line from Lorain, Ohio, on Lake Erie to the Hocking Valley and other coal fields along the Ohio river. A line is also projected into the coal fields of Pennsylvania near Pittsburg.

LOS ANGELES & SAN DIEGO BEACH (ELECTRIC).—Incorporation has been asked for by E. S. Babcock and associates for a company under this name at San Diego, Cal., with a capital of $6,000,000. The company proposes to build an electric road from Los Angeles southeast to San Diego, about 150 miles, and to take over the franchises held by the Lajola and National City of the latter place.

LOUISVILLE & NASHVILLE.—The first freight train over the new line of this company between Knoxville and Atlanta, was started on March 20. The road will not be opened for passenger traffic for several months.

LOUISVILLE, HENDERSON & ST. LOUIS.—This company recently completed an extension by which it reaches Louisville over its own rails. Previously it used the tracks of the Illinois Central. The company is planning to build freight terminals in Louisville to cost $500,000.

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE.—Barnard & Goeder have the contract to build 45 miles of an extension of this road, and will sublet part of the work. Work is to be begun at Garrison, N. Dak. N. W. Barnard, Crookston, Minn., may be addressed.

MISSOURI, IOWA & NEBRASKA.—Incorporation has been granted this company in Missouri to build a railroad from Millard, Mo., northwest through Adia and Putnam Counties in Missouri, and through Appanoose, Wayne, Clark, Madison, Adai, Guthrie, Audubon, Shelby, Crawford, Monona and Woodbury to Sioux City, Ia., approximately 290 miles.

PENNSYLVANIA ROADS.—A charter has been granted to a company in Pennsylvania to build a railroad five miles long, from Shady Grove to a point near the intersection of the Hagerstown & Northern. The company has a capital of $50,000, and Christian W. Lynch, of Harrisburg, is President. The Directors are: Abner C. McKee, John S. Lynch, Alfred G. Miles, Donald C. Haldeman, Richard C. Haldeman and Theodore Zeiders, all of Harrisburg, Pa.

QUEBEC SOUTHERN.—This company will extend its line from Francois to Chaudiere Junction, and hopes to have the work completed as far as Becarcour this year. The Dominion Government has granted a subsidy of $3,500 per mile.

SOMERSET.—This company, which is building an extension from Bingham, Me., to Birch Harbor on Moosehead Lake, about 50 miles, has completed work as far as Moxie Pond, 18 miles from Bingham, and expects to have the entire 50 miles completed this year. The contract for the remaining portion of the work has just been let. The road will connect with the Canadian Pacific at a point about three miles west of Asquith, Me.

WEATHERFORD, MINERAL WELLS & NORTHWESTERN.—Announcement has been made that this Texan road, which was bought about two years ago by the Goulds, and now forms a part of the Texas & Pacific system, will be extended northwest from Mineral Wells to a connection with the Pecos Valley road, about 300 miles. Contracts are shortly to be let for building the first 100 miles, from Mineral Wells to Throckmorton. The road will parallel the Fort Worth & Denver City for about 100 miles. It is proposed ultimately to extend it to a connection with the Denver & Rio Grande in Colorado, connecting these two sections of the Gould System.

RAILROAD CORPORATION NEWS.

BOSTON & ALBANY.—Gross earnings for the six months ended December 31 were $5,784,962, an increase of $378,029; net earnings, $2,008,841, an increase of $116,875, surplus after charges $232,963, an increase of $4,850.

CANADIAN PACIFIC.—The shareholders have ratified the proposal to increase the common stock from $110,000,000 to $150,000,000. The President announced that $20,280,000 additional stock would be issued at once, making the total outstanding $121,680,000. The new stock will be entitled to the dividend of December 31, 1906, if fully paid up. (Feb. 16, p. 56.)

CHICAGO & ALTON.—The stockholders have agreed to the consolidation of the Chicago & Alton Railroad and the Chicago & Alton Railway under the name of the Chicago & Alton Railroad. The stock of the merged company will be $40,000,000, as follows: $899,300 cumulative 4 per cent. preferred, $19,557,900 non-cumulative 4 per cent. preferred, and $19,542,800 common. Three shares of the cumulative preferred stock will be exchanged for each of the 73 shares outstanding of the preferred stock of the C. & A. R. R., and two shares of the new cumulative preferred for each of the 4,287 shares common stock of the railroad company outstanding. The non-cumulative preferred and common stock will be exchanged share for share for the similar amounts of preferred and common stock respectively outstanding of the C. & A. Railway Co. (Jan. 26, p. 30.)

CHICAGO, CINCINNATI & LOUISVILLE.—In answer to injunction proceedings instituted by the Pere Marquette to restrain W. A. Bradford, Jr., President of the C., C. & L., and Rudolph Kleybolte & Co. from forcing the Pere Marquette to pay interest on the $3,500,000 P. M. and C., H. & D. joint collateral 4 per cent. bonds of 1914, the defendants have filed statements to the following effect:

Mr. Bradford accuses J. P. Morgan & Co. of entering into a conspiracy to break up the Great Central Route and divide its component parts among various other roads in which Mr. Morgan holds a large interest. The Chicago, Cincinnati & Louisville was wrecked, he says, for the benefit of the Monon line, a Morgan property; the Pere Marquette is being put in a position to be turned over to the Erie; the Cincinnati, Hamilton & Dayton is to be removed as a competitive factor by being absorbed by the Chesapeake & Ohio; the Toledo Terminal Railroad Company is to be taken over by various Morgan properties entering Toledo, and the Chicago, Cincinnati & Louisville, Mr. Bradford's road, after being wrecked, is to be bought in at a low price by the Southern or the Queen & Crescent, both Morgan properties.

As part of the answer, Rudolph Kleybolte filed the report of J. T. Odell, now President of the Suffolk & Carolina, to the Pere Marquette on the condition of the Chicago, Cincinnati & Louisville just prior to the acquisition of the C., C. & L. by the Pere Marquette and the Cincinnati, Hamilton & Dayton. The report says in part: "For a new road, its condition is excellent. It is laid with 70-lb. steel for most of the way, and the balance with 80-lb. steel. The road crosses 20 other roads in the entire distance, 11 of them over and above grade and the balance are grade. All but two of the grade crossings are equipped with the interlocking device and at all the large cities all the grade crossings at open streets have been eliminated, crossing the streets overhead and on steel girders, with concrete abutments. The length of the line from Griffiths to Cincinnati is 253 miles and from Griffiths to Chicago 30 miles, a total of 288 miles, as compared with 305 miles by other roads. I do not see why a combination of the Cincinnati, Hamilton & Dayton and this road, with the prestige of the Cincinnati, Hamilton & Dayton, would not make the strongest line in existence between Cincinnati and Chicago. It is 20 miles the shortest at all events, if that counts for anything. I do see, however, when this line is fully completed and equipped, they can fix a rate far below anything now in existence, and make more than the other lines at the higher rate. I think the fact that this line exists and will do business stands as a menace to every other Chicago and Cincinnati line. It's the strongest proposition that I know of of its kind."

CINCINNATI, HAMILTON & DAYTON.—Gross earnings during the month of January were $1,248,978; disbursements, $1,084,683.

See Chicago, Cincinnati & Louisville.

INTERBOROUGH-METROPOLITAN.—The time for the deposit of securities of the Interborough Rapid Transit, Metropolitan Securities and Metropolitan Street Railway expired March 16. At that date 95½ per cent. of the I. R. T. stock had been deposited, 93½ per cent. of Metropolitan Securities, and 81½ per cent. Metropolitan Street Railway.

KANSAS CITY SOUTHERN.—At a meeting of the stockholders on March 19, it was voted to issue $5,100,000 six-year 5 per cent. collateral notes, this sum to be spent within the next two or three years for betterments. The notes are to be secured by an issue of $10,000,000 4½ per cent. 20-year improvement bonds, redeemable at any interest date on 60 days' notice.

MICHIGAN CENTRAL.—Gross earnings for the year ended December 31, 1905, were $23,283,868, an increase of $1,790,924; net earnings, $4,417,952, a decrease of $33,978. The surplus after dividends was $223,934, an increase of $100,679.

MINNEAPOLIS & ST. LOUIS.—A special meeting of the stockholders has been called for April 11, to act on a proposition to aid the Minnesota, Dakota & Pacific in the construction of its proposed road from Watertown, S. Dak., to a point at or near Lebeau, with a branch from Conde to Leola, 240 miles in all. The plan is to issue $5,000,000 five-year 5 per cent. notes, secured by a trust indenture executed to the Central Trust Company, trustee.

NEW YORK CENTRAL & HUDSON RIVER.—A meeting of the stockholders has been called for April 18 to authorize an increase of capital stock from $150,000,000 to $250,000,000. There is now $149,442,500 stock outstanding.

Gross earnings for the month of February were $6,582,125, an increase of $1,186,790.

PERE MARQUETTE.—See Chicago, Cincinnati & Louisville.

PITTSBURG & LAKE ERIE.—In the annual report, the President makes the following statement: "On November 2, 1905, the Pittsburg & Lake Erie Railroad Company made a first and partial payment to the Little Kanawha syndicate toward the acquiring of railroad properties and franchises in West Virginia, Ohio and Pennsylvania controlled by it, the purchase to include the Little Kanawha Railroad, Burnsville and Eastern Railroad, Buckhannon and Northern Railroad, Belington & Northern Railroad, Parkersburg Bridge & Terminal Railway, Marietta, Columbus & Cleveland Railroad, Zanesville, Marietta & Parkersburg Railroad and other properties. On the same date the company acquired by purchase the entire holdings of the Greene county syndicate, owning railroad properties and franchises in Greene and Washington Counties, Pa." In another part of the report, $1,504,721 is given as the amount of this payment.